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Chemical Research and the Textile Industry

***By* ALAN A. CLAFLIN**

THE textile industry is in a depressed state. It is an easy thing to say, and a popular one where textile chemists are concerned: "Well — what would you expect? The industry will not spend a cent for research." There are a great many industries that are in a depressed state, some may have spent more on chemical research than the textile industry. Many have spent much less. While it is true that co-operatively the textile industry has spent less money in proportion to its magnitude than many other industries, individually, members of the textile industry have spent generously. Looking back over the development of modern chemistry it will be found that many of the great names centered around, and much of the progress, radiated from the textile industry. Chevreul, who demonstrated the chemical constitution of fats and oils, was chemist for the Gobelin tapestry works. Tennant invented bleaching powder practically at the behest of Lancashire cotton manufacturers. Mercer, Crace-Calvert, Lightfoot, Koechlin are a few names that come to mind as able chemists who were employed by the textile interests when other industries did not know what a chemist did. Sir William Crookes began his professional career in a cotton print works. Perkin's Mauve might have died still-born had the textile industry been as backward chemically in the 1850s as were many other great industries. The great coal tar color industry owes as much to the fact that the textile industry was awake chemically and ready to apply its products as it does to the laboratory workers who devised and invented them and the engineers who made their production economical.

Relation of Research to Prosperity

One may recognize all this, but say, "That is ancient history, how about to-day? See what General Electric, American Telephone & Telegraph and General Motors are doing. Those concerns are spending millions on research and they are prosperous. The textile industry has ceased to spend and it is decadent." Now, is it not fairer to say that the industries that are spending millions in research are prosperous because their scientists have virgin fields to explore. Chemical research will pay, and pay prodigiously, if it has a virgin field, it will not do impossibilities. The British Government spent thousands of pounds on chemical research for the benefit of the indigo planters of Bengal, but it did not delay a year the replacement of the natural indigo by the synthetic product. The wood distilling industry now pleads for chemical research and is willing to spend for it, but probably it is a hopeless gamble, or at best merely a temporary prolongation of life, synthetic methanol, and acetic acid from acetylene, make kraft paper, wall-board and composition lumber a more profitable utilization for small wood and wood waste. This gloomy review is not given to make more difficult the already arduous labor of those who are asking the textile industry for funds for research, but to bring to light arguments which if unexpressed and unanswered will remain handicaps. Facts should be recognized as facts and if there is a future for chemical research in the textile industry, and I surely believe there is one, is not the time ripe to make a preliminary survey, to see what unexplored territory is disclosed?

Textile Industry Largely Mechanical

In the main, the textile industry is a mechanical industry, fibers come in as fibers and go out as fabric, but the fiber itself is unchanged, it is cleaned, lubricated, cleaned again and dyed, may be polished or stiffened, but is still a fiber. †True, there is a whole new technical science of synthetic fibers, but no one is questioning the value of research in this branch of the textile industry, the rewards are self-evident and the penalties equally obvious for those who are niggardly in this department. Research in regard to the production of the synthetic fibers is not usually included among the problems of the textile industry proper. The interest of the textile industry begins when the fibers are provided. If chemistry were a static science it could be fairly said that the problems of the textile industry had been investigated and in a large measure solved seventy-five or fifty years ago and that all that is needed is for the textile chemist to keep

pace with the times, to investigate new cleansing or bleaching agents, new dyes and finishing materials as they are offered to the industry. This keeping pace is of itself a fair sized task, particularly when the complications are considered that are brought in by the synthetic fibers. Undoubtedly, rayon and acetate cellulose have directed the attention of many mill executives to the potential value of a chemist's services who otherwise would have felt that they could drift on the current created by chemical research half a century or so ago.

Chemistry a Changed Science

Chemistry to-day is not the same science it was when John Mercer devised the process which bears his name, which, by the way, lay dormant for thirty odd years, its real value unrecognized for a full generation, nor is it the science it was when Graebe and Leibeman synthesized alizarine nor when Schitzenberger reduced indigo with hydrosulphite. Even Bayer's magnificent achievement of artificial indigo with its world-wide economic effect and Rene Bohn's production of indanthrene blue are really of the chemistry of the past. Chemistry is now a far more fundamental science than it was when Germany's coal tar color industry reached its zenith. Chemistry is merged with physics, no one can say where one begins and the other ends. It is not probable that the first real duty of chemical research in the textile industry is to re-examine the old processes in the light of this modern science. When the major part of the chemical processes used in the textile industry were being empirically discovered and likewise as empirically standardized, chemistry was a study of a vast number of different entities. It was the age of expansion, diversification and differentiation. To-day is a period of generalization, a converging instead of radiation of paths of knowledge. While it is perhaps premature to say chemistry has ceased to be the study of the actions and reactions of ninety-two separate, distinct and indivisible elements and become the mathematical consideration of one or, at most, two immaterial and intangible concepts, termed force, energy or positive and negative electricity. It is probably only a few years, surely not a generation, premature to make this statement. To-day, it is true, much of the progress in chemistry continues to come from following the old paths of thought, to practical chemists the speculations and demonstrations of Planc, Lewis (Schroedinger) Bohr, Sommerfeld and other physicists seem as remote from material significance as must the electrical experiments of Faraday to the engineer of a hundred years ago, or the mathematical achievements of Clark Maxwell to the average scientific student of his time.

Value of New Approach

It often seems that in the beginning of a new scientific approach, in the theoretical discussion of a subject, that familiar facts are merely given new names, a strange nomenclature is devised, and simple phenomena additionally complicated and that real progress is temporarily obscured by language obfuscation. Colloid chemistry, that peculiarly practical branch of physical chemistry, has particularly suffered in this respect. However, this handicap is being overcome, already industrial chemists are finding it not too much strain on the imaginations to consider there is some correlation between a viscid solution and a precipitate that will not settle. Even the free energy of surfaces may not be an expression of vague mysticism to the textile chemist who observes dyes leave their solution and become affixed to a fiber, while a detergent solution effects the reverse. A beginning in the application of the theory of electrolytic dissociation to practical problems is the determination of hydrogen ion concentration. Probably the results thus far obtained from pH measurements have been disappointing. Where the intricacies of the hydrogen electrode have been mastered, the potentiometer has not disclosed a practical necessity for such exact control. The simpler method, from an operating standpoint, of standardizing colorimetric changes as yet has not been sufficiently developed. Textile operations usually admit a fairly wide range of hydrogen ion concentration without affecting a material difference in the result and these ranges have been empirically established by long practical experience. The buffering effect of soap solutions in the alkaline range and of assistants like Glauber's salt and ammonium and sodium acetates in the acid range have been practically recognized even if the underlying scientific explanation was not understood.

Importance of Creation of Standards

This does not mean, however, that standards for optimum results should not be determined and defined. In wool scouring and silk degumming great economies may be obtained and much damage to the fiber prevented by the establishment of practical control methods based on potentiometric measurements. Even if this simplest application of physical chemistry methods contributes nothing of great practical value it should be appreciated that a new door has been opened, a new channel of approach created. How far knowledge will progress through this new approach depends on the skill and vision of the research workers and the support they are given by the industry. It is a little over twenty years since the possibilities of applying hydrogen ion measurements to the consideration of practical problems of acidity and alkalinity has been generally recognized. About ten years of this time has been spent in developing methods. The second ten years has been accupied in applying these methods to the industries. In some industries, notably tanning, electroplating and purification of water, great practical benefits have already been established. In the textile industry, which has been late, anyway, in looking into these methods, results on the whole have been disappointing thus far, as already stated. This should not engender discouragement, but serve to incite further study. From a technical standpoint the measurement of oxidation and reduction potentials is about as far advanced to-day as was that of the acidic hydrogen ion twenty years ago. It is entirely probable that the next ten years will see practical potentiometric methods devised for such

measurements. A great many textile processes, notably those of dyeing with vat colors and bleaching with oxidizing agents, have a great deal to gain by more exact methods of controlling the reagents used. Surface tension, preferential wetting, penetration, all different aspects of similar phenomena are beginning to come to the textile chemist's attention. As yet there has been very little systematic work on the subject, neither fundamental mathematical research nor even critical accumulation of the many scattered observations with attempt at generalization or elucidation of underlying principles. Willard Gibbs is revered in vague recollection as a pioneer, but there is no apparent appreciation that a review of his work in the light of to-day's broader knowledge might contribute something of value to textile chemistry. A little excursion into colloid chemistry and cognizance is taken of the existence of surfaces, but how largely practical operations are influenced by the relation of such surfaces is generally overlooked. Textile chemistry, in fact, almost all applied chemistry, has to do with the relation of surfaces, even in gaseous reactions it is what may be considered the electrons on the surface of an atom that have the reacting energies. Catalytic reactions are in all probability phenomena of surface concentrations. One of the earliest applications of a catalytic reaction is that of the oxidation of aniline black with a vanadium catalyst, but since that single venture into the domain of catalytic chemistry, textile chemists have apparently rested satisfied. Meanwhile catalysis has revolutionized the manufacture of sulphuric acid, made atmospheric nitrogen not only the scourge of mankind in that synthetic nitric acid was a fundamental factor in prolonging the World War four years, but also the savior of mankind in that the nitrogen exhaustion of our soils foreseen by Sir William Crookes is forever postponed. It pronounced the nemesis of the wood distilling industry by the production of synthetic methanol and acetic acid from acetylene, and further created a vast horde of synthetic organic compounds which have wrested the productive field of research for the present from aromatic to aliphatic organic chemistry. Probably the cause of this hiatus in the application of catalytic process to textile chemistry is to be found in the ignorance in regard to the function played by surfaces, not minute, almost theoretical surfaces, but the real tangible, evident surfaces of the textile fibers. These surfaces are presumably the material influences that affect the factor of time, so evident in all textile chemical operations. Why does it take several hours to bleach a fiber, or from three-quarters of an hour to two hours to dye a fabric? If the forces at play are electrical, and there is every reason for this assumption, why do the reactions take so long, simply that there is a delay in getting the reacting particles to the reacting surfaces. While it has been earlier stated that the province of textile chemistry begins when the fibers are provided, textile chemistry cannot ignore what are to be the fibers of the future. Will the cotton fiber be a product of botanical research, or will such research merely provide a raw material for the synthetic fiber factory? X-ray researches show that the strength of fibers lies in their molecular arrangement; will it be possible to control such arrangement in synthesis so that fibers may be made not as strong but much stronger than can be grown? Urea, that first connecting link between organic and inorganic chemistry, is already synthesized from its elementary components, does that forecast that synthetic proteins are only around the corner, and that wool fiber and silk fiber may be produced eventually as successfully as is rayon today? Too much speculation is not, however, the purpose of this survey, it is rather to indicate that the new combination of physics and chemistry is a science that opens new vistas for the textile chemist. While the philosophy of modern physics becomes more imaginative and immaterial as it is welded with chemistry it becomes more and more practical, and with splendid augury for the future of the textile industry.

New Wetting Out Agent

The Dyestuff Department of E. I. du Pont de Nemours & Company announces Alkanol, a new wetting out and dispersing agent. It is said to act on cotton fibers in all forms to render them easier to penetrate by the solutions used in processing, dyeing and printing.

In announcing Alkanol, the company states that due to its softening properties, it aids in removing impurities such as burrs, waxes, etc., speeds up the boiling out process and is very valuable in kier boiling as an assistant in removing natural impurities from cotton goods.

Due to its wetting out action, Alkanol is claimed to be of use for speeding up the solution of dyestuffs as well as for shortening the time required for de-sizing and bleaching.

When used for mixing with oils in the preparation of wool it is said to produce more uniform absorption of the oil and thus improve the spinning qualities of the wool.

Alkanol is a very fine, light, cream colored powder, readily soluble in water. In solution it is a practically colorless liquid which it is claimed will not discolor vegetable fibers when used in suitable quantities to produce the most effective results.

New Indigosols

As two new representatives of the Indigosol series, the General Dyestuff Corporation offers Indigosol Violet IBBF and Indigosol Purple IR. Both are said to be of particular interest in textile printing because of their good fastness properties, fine shade and easy method of application. They may be used for colored chlorate discharges and for aniline black resist styles. Sol. 30 and 31.

Indigosol Scarlet IB and Indigosol Brown IRRD are two further members of the Indigosol range to be distributed by General. They are dyed in an acid bath, developed with bichrome and sulphuric acid and are said to have excellent fastness to light, washing and milling. They are particularly recommended for fast wool dyeings.

Practical Applications of Visual Spectrophotometry*

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PROBABLY the three most important practical applications which the scientist makes of visual spectrophotometry are in the identification of dyes (and other colored substances), in their quantitative analysis and in indicator practice.

The Identification of Dyes

The identification of dyes is a necessary prerequisite for their analysis, in order to enable the analyst to make an intelligent choice of analytical methods and a reliable interpretation of the results obtained therein. Even when dyes are not analyzed, the question of their true identity is one of importance to scientists. Dyes are frequently supplied under names which are either decidedly indefinite or positively misleading. The value of much of the varied scientific investigation which has been carried out with the aid of dyes has been seriously impaired by the failure to determine the precise character of the dyes employed.

Both chemical and physical methods are resorted to in the identification of coloring matters. Chemical methods are reviewed in the sixth volume of the recent fifth edition of Allen's Commercial Organic Analysis. In general the chemist will rely almost entirely upon the analytical scheme outlined by Green[1] in which variations in solubility, reactions with reagents, dyeing properties and behavior with reducing and oxidizing agents are utilized. Such methods are of excellent service in determining the general type of dye under investigation but are usually inadequate for distinguishing between different dyes of the same type. They will enable the analyst to determine that a given dye is a basic violet of the triphenylmethane class, for example, but will not be of the least service in disclosing whether it is methyl, crystal, benzyl or ethyl violet.

Technical dye testers frequently develop somewhat different methods of chemical examination which are, however, subject to similar limitations. In general, chemical methods which are convenient in application are of little use in distinguishing between similar dyes, and even the most laborious chemical research may prove futile. Such methods may answer all practical requirements for technical applications of dyes in which the definite identity of the coloring matter may be immaterial, but are unsuitable for the examination of products to be employed in scientific investigations.

The azo groups of dyes constitute a possible exception to this generalization. The physical (spectroscopic) methods of dye identification, which will be outlined subsequently, are somewhat less effective with azo dyes than with other dyes in general and a resort to chemical methods may sometimes prove advisable. Azo dyes yield characteristic reduction products and the isolation and identification of these will serve in turn to establish the identity of the original dyes. A comprehensive digest of data suitable for this purpose has been made by Holmes[2].

In practice, however, these methods are laborious and it may be questioned if they often result in more positive identifications of dyes than may be obtained by rapid and convenient spectroscopic methods.

The most recent contribution of importance in connection with the chemical identification of azo dyes involves spectroscopic as well as chemical methods[3]. The isolated reduction products of the dyes are identified spectroscopically, either directly or more generally, after conversion into coloring matters by suitable means. The scheme finds justification by reason of the fact that the identification of a limited number of such reduction products enables the analyst to identify relatively unlimited numbers of azo dyes. In view of the labor and difficulty involved, it seems probable that such a procedure would seldom prove more advantageous then the direct spectroscopic examination of the original azo dyes themselves.

Spectroscopic Dye Identification

In the spectroscopic method of dye identification, as developed by Formanek[4], dyes are grouped in accordance with color, sub-grouped on the basis of the general characteristics of their absorption spectra and the manner in which they undergo modification with certain changes in conditions, and ultimately identified on the basis of the locations of their absorption maxima. The method is applicable to the great majority of dyes and the necessary data available. It is rapid and convenient in operation. In general it is greatly superior to chemical methods, affording more positive identifications and enabling the analyst to distinguish readily between similar dyes, in many instances, which cannot be differentiated by chemical means easily, if at all.

* Submitted in partial fulfillment of the requirements for the Associate Chemist examination offered by the United States Civil Service Commission.

The effectiveness of the spectroscopic method, however, depends principally upon very precise determinations of locations of absorption maxima. Differences between maxima with closely related dyes are frequently slight, and the precision with which they may be located has limitations. Results may be influenced by the type of instrument employed and by the technic and the skill of the operator. In view of these considerations it appears probable that the spectroscopic method will be supplanted eventually by spectrophotometric methods of the type which have been developed at the Color and Farm Waste Division of the Bureau of Chemistry[5].

Spectrophotometric Dye Identification

The absorption spectra of dye solutions undergo decided modifications in form and intensity with variations in solvent, dilution, acidity and alkalinity. The general character of these modifications is dependent upon the general structural type of the dye and the degree of modification is influenced by minor constitutional differences. In the spectrophotometric method of dye identification suitable ratios are employed for quantitative absorption measurements (extinction coefficients) which measure such modifications under regulated conditions. Values thus obtained are highly characteristic and have been shown to be effective for the differentiation between closely related dyes of a number of groups which present considerable difficulty in identification.

In subsequent investigations Holmes and Peterson[6] showed that a similar ratio, of extinction coefficients at wave lengths selected at moderate intervals on both sides of the absorption maxima of the dyes to which they were applied, is of great utility. A ratio of this type defines the spectral location of absorption bands with considerable precision. Its employment affords a very convenient means for identifying dyes and obtaining information, as well, respecting their relative purity. Subsidiary coloring matters give decidedly different numerical values for the ratios than do the dyes with which they are associated. Various samples of market supplies of dyes usually contain varying minor proportions of subsidiary dyes which modify, in some degree, the values obtained. In such instances the values obtained may serve to indicate the approximate degree of purity in the sense specified.

All such methods of identification are applicable not only to coloring matters but also to all substances which may be converted into coloring matters readily. An excellent example is that of phenols. These were converted into phthalein dyes by Gsell[7] and by Formanek and Knop[8], into azo dyes by Palkin and Wales[9] and into indophenols by Gibbs[10]. In each instance the original phenols are identified by determining the identity of the resulting dyes by means of the spectroscope or spectrophotometer. In some instances such reactions may be employed for purposes of quantitative analysis as well as of identification.

The Quantitative Analysis of Dyes (Spectrophotometric)

Although a variety of different methods have been proposed and employed for the quantitative analysis of dyes only two methods may safely be employed extensively. Chemical reduction with standard solutions of reducing agents (preferably titanous chloride)[11] and spectrophotometric evaluation give relatively reliable results in general, and both are applicable with the great majority of dyes. Other methods are less universally applicable and are liable to prove misleading when employed with such inferior grades of dyes as are frequently obtained on the market[12]. The titanous chloride and spectrophotometric methods are about equally accurate. The average probable error in results seldom exceeds 1 per cent.

The theory of the spectrophotometric evaluation of dyes is simple. It is well known that the absorption bands of dyes vary in both location and intensity with change in solvents. With any given solvent, however, under given suitable conditions, the extinction coefficients of dye solutions vary in direct proportion with their dye concentrations. (In other words, dye solutions obey Beer's Law[13] under the proper conditions.) Having once obtained absorption data (extinction coefficients) on a solution of a given dye of known dye concentration under regulated conditions, the dye contents of all future samples of that dye may be determined readily on the basis of their comparative absorption when examined under the same conditions.

The spectrophotometric evaluation of dyes, however, is less simple than might be supposed. All factors which may effect either the chemical or the physical dye molecule require consideration, and a judicious technic is essential if appreciable errors are to be avoided.

The choice of solvent is of the first importance. Although aqueous solutions have commonly been employed for the purpose, water is, in reality, a relatively unsuitable solvent for a variety of reasons. Anomolous results are frequently obtained with variation in the concentration of coloring matters in aqueous solutions[14].

It has been shown that aminated dyes of a considerable number of constitutional types undergo radical modifications in absorption spectra when their aqueous solutions are diluted. The typical phenomenon is one of progressive transition between two definite bands of widely separated spectral location, indicative, in all probability, of a state of equilibrium between two tautomeric forms of the dyes. The dilution ranges in which these changes occur often coincide with the practical working ranges in colorimetric or spectrophotometric practice. In such instances Beer's Law is necessarily inoperative since the analyst is dealing, in practical effect, with a mixture of two dyes of which the relative proportions vary with every change in concentration, rather than with a single homogeneous substance or mixture of substances. Appreciable errors may result[15] when solutions evaluated are of different concentration from those employed in obtaining the standard data, as is frequently the case in ordinary spectrophotometric practice.

In dealing with aqueous solutions of single dyes such anomolous dilution effects may be avoided by insuring that all measurements be made at nearly

identical concentrations of dyes, but this course would not be feasible when dealing with dye mixtures. Spectrophotometric methods are exceptionally valuable in the analysis of dye mixtures and it is desirable that any technic adopted should be applicable to them.

An excellent solvent for general employment with dyes is a mixture of equal volumes of water and alcohol[16]. In this dyes seldom, if ever, undergo any appreciable tautomeric alteration on dilution.

With basic dyes this solvent has the added advantage over water, of precluding appreciable errors which may otherwise arise from the absorption of dye base on the surface of containing flasks or absorption cells.

The same solvent appears to be favorable to molecular dispersion with dyes in general. Light absorption decreases with increasing molecular aggregation[17] and whereas numerous dyes yield somewhat colloidal solutions with water, on the one hand, or with alcohol, on the other, their solutions are seldom appreciably colloidal in 50 per cent alcohol.

Whatever solvent is employed, it should be "regulated" by means of buffer agents if the analyst is called upon to deal with any extensive variety of dyes. Although the spectra of most dyes are stable to minor variations in hydrogen ion concentration in approximately neutral solutions, there are numerous exceptions. In some instances, as with the derivatives of fluorescein, the intensity of absorption undergoes modification with change in hydrogen ion concentration[18], and in other instances, as with Fast Green FCF[19], the spectra are modified in other and more radical ways. Since such dyes may be evaluated accurately only when examined at a definite hydrogen ion concentration, and since the analyst may be called upon to analyze mixtures of dyes containing them, it is advisable to obtain the basic data for the analysis of all dyes under regulated conditions.

The same considerations hold with regard to minor details in technique which might appear relatively unimportant. In so far as may be possible a "standard" routine should be followed. The stock solution of dye should be made up and diluted in a definite manner and the readings made without undue delay. With the great majority of dyes variations in such details are without effect but in instances in which the dye solutions are distinctly colloidal it is important to regulate the physical state of the solution at the time of measurements as definitely as possible.

The effect of such minor variations in temperature as are ordinarily encountered are negligible in general practice[20]. Apparently a decided increase in temperature usually results in only a very slight decrease in absorption. With dyes which have indicator properties under the conditions of examination, a variation in temperature would also affect absorption indirectly through its effect upon dissociation constants.

Whereas the advisability of employing one general solvent together with a technique which is invariable in every minor detail has been emphasized, since that course is a necessity in dealing with dye mixtures, it is obvious that no possible general method will yield the best results with all dyes. If the analyst is interested only in evaluating individual dyes he should determine the conditions which are most satisfactory for such particular dyes.

Dye Mixtures

With dye mixtures spectrophotometric methods are exceptionally convenient and valuable. The separation of the components of such mixtures by repeated extractions with immiscible solvents or other means is laborious and usually proves decidedly unsatisfactory. It has been shown possible to analyze such mixtures directly by the reduction method, in instances in which the components are reduced with variable facility, by means of a suitable regulation of the hydrogen ion concentration of the solutions, but this method has definite limitations[21]. The spectrophotometric method is even more convenient and has a far wider range of utility.

The absorption of a mixture of two dyes is the simple sum (expressed in extinction coefficients) of the absorptions of its components.

For the analysis of a dye mixture[22] the analyst needs only to measure its absorption under conditions which are identical with those which have previously been employed in obtaining standard absorption data for the component dyes. Measurements need be carried out at only three wave lengths for the purpose, the wave lengths selected being those of the respective absorption maxima of the two dyes in question and the wave length of intersection of absorption curves of equivalent concentrations of those dyes. At the latter wave length the extinction coefficient of the dye mixture is unaffected by variations in the relative proportions of the dyes, and affected only by the dye concentration. The ratio of coefficients obtained at the two dye maxima, on the other hand, is unaffected by variation in total dye content and affected only by variation in the relative proportions of the dyes. Measurements at these three points accordingly supply all the data required for the analysis of a mixture of two dyes.

This method is generally applicable in all instances in which the dyes in question differ decidedly in color and in spectral positions of their absorption bands. It could hardly be recommended for employment in instances in which the spectral interval between dye maxima is less than 20mu, and proves thoroughly satisfactory only when the interval in question is appreciably greater. Under favorable conditions, however, the results obtained are excellent. In some instances mixtures of three dyes may be evaluated on similar principles.

With mixtures of dyes which are very similar in color and absorption it is necessary to rely upon the type of ratio (described before) which has been advocated for use in the identification of dyes. The differentiation afforded by such a ratio decreases as the spectral interval between maximum decreases and is seldom or never as precise as may be desired. Even with this type of ratio the results obtained may be of great value. It has been shown, for example, that it is possible to determine the relative proportions of methylene blue and trimethyl thionine[23] in mixtures of those dyes within an error of about 3 per cent by the simple measurement of such a ratio. Although the results obtained in this manner are somewhat crude they are frequently decidedly more accurate and reliable than any otherwise obtainable by the most laborious means.

Indicator Practice

Spectrophotometric methods were applied in indicator practice at about the same time by Brode[24], by Holmes[25] and by Thiel, Dassler and Wilfken[26].

Indicator changes are accompanied by radical alterations in spectra. The degree of transformation of any indicator at any definite hydrogen ion concentration within the range (or ranges) of its utility may be measured spectrophotometrically and given numerical expression in terms of spectrophotometric ratios. The calibration of such ratios against known hydrogen electrode values yields data which may subsequently be used in determining the Sorensen exponents of solutions of unknown hydrogen ion concentrations.

Two types of ratio may be employed with indicators. With 1-naphthol-2-sulfo indophenol[27], for example, which passes from the red free phenol to a blue dye salt between the pH values of 5.7 and 11.7 (the useful indicator range being confined, however, to from pH 7.7 to pH 9.7) it is possible to employ a ratio which measures simply the degree of the development of the blue dye salt form. The observed extinction coefficient at 630mu is divided by the predetermined extinction coefficient at that point of an equal concentration of indicator under conditions insuring complete conversion to the dye salt. The resulting ratio equals the percentage dissociation of the indicator in decimal terms.

With the same indicator the ratio of extinction coefficients at 500mu and 630mu might also be employed for the same purpose, in which event the analyst is measuring the relative proportions of the two indicator forms in precisely the same manner as that in which he determines the relative proportions of the two components of a dye mixture.

The first type of ratio may be employed only when the two indicator bands are so widely separated that the absorption of the one is not influenced by that of the other, and its use involves a careful regulation of solution volumes to insure a known indicator concentration.

The second type of ratio affords a maximum degree of numerical alteration per unit change in indicator dissociation, since both the increase in one absorption band and the simultaneous decrease in the other contribute to that end. It does not necessarily afford greater accuracy, however. With the sulfonphthaleins[28], for example, the bands of the acid forms of the indicators occur in a spectral region in which the average eye is relatively insensitive, and most analysts, accordingly, would probably prefer to use ratios of the first type. Even in the instances of such indicators, the second type of ratio may occasionally prove very useful owing to the fact that it is unaffected by variations in indicator concentration and may be employed without any precise regulation of solution volumes.

The actual calibration of such spectrophotometric ratios against pH values determined by the hydrogen electrode is unnecessary provided the indicators to be used have the normal behavior of monobasic acids and provided their apparent dissociation constants are known. It is only necessary to measure the spectra of the indicator under conditions which insure complete conversion, respectively, into its acid and salt forms. It will then be possible to calculate its complete spectrum, and the values of its ratios of either type, for any given hydrogen ion concentration within its transition range.

The accuracy of spectrophotometric methods with indicators is excellent, and it appears probable that they will find extensive application[29].

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[1] Green, Analysis of Dyestuffs, 3rd ed., London, 1920.
[2] Holmes, Amer. Dyestuff Reporter, 14, 647 (1925) et seq.
[3] Fierz-David, Kunstliche organische Farbstoffe (Technologie der Textilefasern), Berlin, 1926.
[4] Formanek, Untersuchungen und Nachweis organischer Farbstoffe auf spectroskopischem Wege, Berlin, 1908, 1911, 1913, 1926, 1927.
[5] Holmes, J. Ind. Eng. Chem. 15, 833 (1923); 17, 59 (1925); 17, 918 (1925).
[6] Holmes and Peterson, Stain Tech., 5, 65 (1930).
[7] Gsell, Z., anal. Chem., 55, 417 (1916).
[8] Formanek and Knop, Z., anal. Chem., 56, 273 (1917).
[9] Palkin and Wales, J. Amer. Chem. Soc., 46, 1488 (1924).
[10] Gibbs, J. Biol. Chem., 72, 649 (1927).
[11] Knecht and Hibbert, New Reduction Methods in Volumetric Analysis, revised ed., London, 1918.
[12] Holmes and Peterson, Stain Tech., 5, 91 (1930).
[13] Beer, Pogg. Ann., 86, 78, (1852).
[14] Holmes, J. Ind. Eng. Chem., 16, 35 (1924).
[15] French, J. Ind. Eng. Chem., 18, 298 (1926).
[16] Holmes, Am. Dyestuff Reporter, April 1926.
[17] Pihlblad, Z. physik. Chem., 81, 417 (1912).
[18] Holmes, J. Am. Chem. Soc., 46, 2770 (1924).
[19] Holmes and Snyder, J. Am. Chem. Soc., 50, 1907 (1928).
[20] U. S. Bureau of Standards, Sci. Paper No. 440.
[21] Holmes, Am. Dyestuff Reporter, 14, 415 (1925).
[22] Holmes, Am. Dyestuff Reporter, 15, 189 (1926).
[23] Holmes, Stain Tech., 3, 45 (1928).
[24] Brode, J. Am. Chem. Soc., 46, 581 (1924).
[25] Holmes, J. Am. Chem. Soc., 46, 627 (1924).
[26] Thiel, Dassler and Wilfken, Fortschritte der Chemie, (1924).
[27] Holmes, J. Am. Chem. Soc., 47, 2232 (1925).
[28] Holmes, J. Am. Chem. Soc., 47, 221, (1925); 47, 226 (1925).
[29] Kolthoff, J. Physical Chem., 34, 1466 (1930).

Institute Research Committee Organized

DR. WARREN E. EMLEY, Chief, Organic and Fibrous Materials Division of the Bureau of Standards, Washington, D. C., was elected Acting Chairman of the Preliminary Research Committee of the United States Institute for Textile Research, at a meeting held at the University Club, Boston, Mass., Sept. 26th, and E. W. McGowan, of the Wyandotte Worsted Co., Waterville, Me., was elected Acting Secretary.

Present at the meeting in addition to Dr. Emley and Mr. McGowan were Prof. George B. Haven, Massachusetts Institute of Technology, Cambridge, Mass.; Prof. Louis A. Olney, Lowell Textile Institute, Lowell, Mass., and Ernest N. Hood, treasurer, Pequot Mills, Salem, Mass. The other members of the committee are Dr. W. F. Edwards, director of laboratories, United States Testing Co., New York, N. Y.; George H. Johnson, research director, Laundryowners National Association, Joliet, Ill., and C. L. Emerson, vice-president, Robert & Co., Atlanta, Ga.

While the research committee, and the entire official personnel of the Institute, are acting merely until permanent organization is effected at the first annual meeting in November, the former committee is now operating as though it were a permanent body, and has developed a plan of research procedure and a large list of tentative research subjects, which later is to be submitted to members and to Institute directors for further suggestions and revision, the perfected list to be discussed by the committee at the annual meeting and a selected list of subjects then assigned to participating laboratories for scientific investigation. The representatives of several laboratories on the committee have already signified their desire to be designated as participating laboratories, and the committee is preparing a selected list to which invitations will be issued to serve the Institute in this capacity. This service will cover investigations that are unlikely to be protracted and will be rendered free of cost to the Institute. The undertaking of fundamental research that is likely to be long drawn out, and requiring special equipment and a large staff, will be deferred until sufficient funds are available, as few participating laboratories could be expected to donate such service free of charge.

The organization of a research information and library service for members, including a regularly published bulletin, has also been outlined by the committee and will be developed as fast as available funds will allow.

Members and Funds Needed

At a meeting of the executive committee of the Institute, held at the University Club the same day, Secretary C. H. Clark was authorized to complete the preparation of literature for a membership campaign and to start the latter as soon as possible. Members of the committee present were President P. J. Wood; Treasurer Dr. E. H. Killheffer; Vice-President Ernest N. Hood and Thomas Talbot Clark, and E. A. Clements, president of the Globe Knitting Works, Grand Rapids, Mich. Commenting upon the present status of the Institute, Pres. Wood says that the officers and committees hesitate to proceed much further with organization work, as they and all of the preliminary directors, who were designated by the leading textile associations and other bodies, are serving merely until permanent organization can be effected. "The Institute by-laws call for permanent organization early in November, and by that time it is hoped that we shall have the co-operation of practically every textile man who is interested in scientific research. Members and funds are now necessary to ensure the success of this movement."

General Dyestuff Releases

The General Dyestuff Corporation has distributed circulars on the following products:

Rapid Fast Bordeaux RX Powder, a new product of the printing series, which is said to be remarkable for its stability, fastness to light and the resistance to dry heat of the undeveloped prints. I. G.-385.

Thiogen New Blue 3GL and FBL are sulphur blues having particular brightness of shade. Both are claimed to have good all around fastness properties and are adaptable for machine or piece dyeing for cotton in all stages of manufacture. I. G.-351.

Benzo Viscose Grey 5B and Benzo Viscose Blue R, are two colors recommended to eliminate "bar effects" when dyeing rayons. Both colors give fairly bright shades and are said to have the fastness properties generally demanded for rayons. I. G.-394.

Benzo Viscose Green B is another of the Viscose colors recommended for eliminating "bar effects." This color is a bright bluish green which the company states has very good fastness to light. I. G.-389.

Katigen Brilliant Blue 3GA, a new sulphur color which is stated as having excellent solubility and very good fastness properties. It is distinguished by its very bright greenish blue shade, and is recommended particularly for dyeings which are not aftertreated. G.-58.

Katigen Brilliant Green 3G conc., a new homogeneous sulphur color which gives a very bright yellowish green shade. It is said to excel the usual sulphur greens by not turning dull under artificial light. The color is recommended for machine dyeing, padding or jig dyeing, but is not suited for materials which are to be subsequently vulcanized. G.-60.

"Rapid Fast Colors in Calico Printing." This new card describes the application of the Rapid Fast Colors available at the present time, and contains a number of printed patterns.

Proceedings of the American Association of Textile Chemists and Colorists

The American Association of Textile Chemists and Colorists

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E. H. KILLHEFFER
Newport Chemical Works, Passaic, N. J.

Vice-Presidents
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Past President and Chairman of the Research Committee
LOUIS A. OLNEY
Lowell Textile Institute, Lowell, Mass.

LOCAL SECTIONS AND THEIR OFFICERS

Northern New England Section—
Henry D. Grimes, Chairman, Washington Mills, Lawrence, Mass.
Harold C. Chapin, Secretary, Lowell Textile Institute, Lowell, Mass.

Rhode Island Section—
Richard B. Earle, Chairman, 133 Power St., Providence, R. I.
A. Newton Graves, Secretary, Franklin Process Co., Providence, R. I.

New York Section—
Robert H. Gaede, Chairman, Gaede Silk Dyeing Co., Paterson, N. J.
Clemens F. Hoppe, Secretary, Oriental Silk Printing Co., Haledon, N. J.

Philadelphia Section—
A. M. Burt, Chairman, 1046 Public Ledger Building, Philadelphia, Pa.
Percival Theel, Secretary, Philadelphia Textile School, Philadelphia, Pa.

Piedmont Section—
R. M. Mitchell, Chairman, 808 Cypress Street, Greensboro, N. C.
Arthur R. Thompson, Jr., Secretary, 1109 Independence Building, Charlotte, N. C.

South-Central Section—
R. S. Wheeler, Chairman, Crystal Springs Bleachery, Chickamauga, Georgia.
J. D. Mosheim, Secretary, Crystal Springs Bleachery, Chickamauga, Ga.

Midwest Section—
Carl E. Bick, Chairman, Real Silk Hosiery Mills, Indianapolis, Ind.
William Bergh, Jr., Secretary, Vassar Swiss Underwear Co., Chicago, Ill.

Lowell Textile Junior Section—
Earle R. McLean, Chairman; Alfred J. Carbone, Secretary.

North Carolina State College Junior Section—
R. A. Gilliam, Chairman, E. B. Hardin, Secretary.

NOMINATIONS OF OFFICERS FOR 1931

The Nomination Committee submit the following nominations for officers for 1930:

President—P. J. Wood, Vice-President and Manager, Oriental Silk Printing Co., Haledon, New Jersey.

Vice-Presidents—William H. Cady, Chief Chemist, Slater Company, Inc., Webster, Massachusetts, and R. D. Sloan, General Manager, National Plant of Standard-Coosa-Thatcher Mill, Rossville, Georgia.

Treasurer—Harry R. Davies, President, Dyestuff Corp. of America, Boston, Massachusetts.

Secretary—Alex. Morrison, Assistant Chemist, American Woolen Company, Andover, Massachusetts.

Councillors for 3 Years—Ralph F. Culver, Vice-President and Manager, Ciba Company, Providence, Rhode Island, and Harold M. Chase, Chief Chemist and Superintendent of Dyeing, Riverside and Dan River Cotton Mills, Danville, Virginia.

Extract from Article 8 of the Constitution—"Counter nominations for any office, signed by at least ten members, may be filed with the Secretary not later than November 1st."

ALEX. MORRISON, *Secretary.*
Chairman, Nomination Committee.

SEPTEMBER MEETING OF NEW YORK SECTION

THE September Meeting of the New York Section of the American Association of Textile Chemists and Colorists was exceptionally well attended. Forty members were present at the informal dinner held at the Hotel Fifth Avenue and about eighty were present at the meeting. Robert H. Gaede, Chairman of the Section, presided. Following the routine business of the meeting, the speaker of the evening was introduced as follows:

Chairman Gaede: We are very fortunate tonight in having a paper presented and a machine demonstrated which is the first of its kind, the Colorscope. Dr. Sheldon, who is Professor of Physics at the Washington Square College and also President of the New York Electrical Society, is here to demonstrate this machine and more than that to explain all about it. Dr. Sheldon! (Applause)

Proceedings of the American Association of Textile Chemists and Colorists

A Demonstration of the Colorscope*

By Dr. H. H. Sheldon

MR. CHAIRMAN and Gentlemen: The task which I have before me at this particular moment appears somewhat more difficult than developing a color machine. I have the feeling that you men know very much more about color than I do. Therefore my natural inclination would be to dive at once into a description of the electrical circuits of this machine and avoid any reference to color. (Laughter) However, past experience has shown that that leads to dissatisfaction on the part of the customer and so I shall, at the risk of being boresome, discuss something of what the color problem actually is.

The greatest array of colors that occur in nature, of course, are given by the spectrum. We can take a beam of light, as Newton first did, and split it up into its various components and as you know they go all the way from the deep violet clear on into the red, and even beyond. But we are interested primarily in colors in the region which the eye can see and that region is from about four thousand angstrom units (that is, .00004 centimeters) up to about the same figure with a seven in place of the four, which gets us into the red. All colors then are made up either of some part of the spectrum or of some combination of those parts.

Our problem then would appear to be a rather simple one, because if we could measure a color in terms of its position in the spectrum, going from the violet all the way down to the red, or the color combination in terms of the colors which go to make that combination, then we should at once be able to place numbers upon those colors, just as I have done here, in pointing out the limits of visibility, and we would then need only to know something about the intensity, (or what I might very loosely call the brightness) and our whole problem would be over. And as a matter of fact if one gets down to the fundamental theory of color that is exactly what one really must do.

On the other hand, we have our problem complicated by factors which are not represented by the positions in the spectrum, or by the brightness. We have for example weave, which complicates our judgment of the whole color, if we use the eye, and we also have sheen.

So that if we are actually to measure any colors which exist at the present time we must either take account of those two things, which are the principal difficulties, or we must in some manner remove them from the picture. And that turned out to be the most difficult thing in the development of the Colorscope.

When I first started on this it seemed like a very easy problem but as I went farther and farther it became more and more difficult, consequently more and more interesting.

If we are to solve this color problem and devise some machine to replace the eye, the trained eye, we must first of all decide what it is that we want to measure. In the textile trade, in fact, in commerce generally, we are not so much interested in how many units of energy may exist in the red or how many units of energy may exist in the violet and all the rest of that, and one reason we are not is because the eye itself does not see uniform energy as uniform. If I were to throw a spectrum on the screen here by means of a large prism and by some device could assure you that I had the same intensity, the same amount of energy, measured in physical units from one end of that spectrum to the other, that wouldn't mean that your eye would react the same way from one end to the other because as you know the eye is most sensitive in the green region, falling off decidedly in the red and also in the violet. Some eyes which are abnormal may have that region of greater sensitivity displaced to one side or the other. Some eyes will see much farther into the red. Others will see farther into the blues. And there are all sorts of peculiarities which you men know fully as well as I do.

So even if I said the energy were the same all the way through, your eye would not respond to it the same all the way through. And when one is selling merchandise he must sell to suit the eye and not to suit any physical instrument which someone may set up as a standard. Therefore what we really want is some device which will most nearly give results which will correspond to those obtained by matching with the eye. That is self-evident.

Various instruments have been devised to match colors and to analyze colors and measure colors. Some of them are extraordinarily old. Up until very recently all of those devices were only meant as aids to the eye. They did not replace it. And it still required the eye of the trained observer along with the instrument to get the result. That then did not remove the personal equation, did not remove the differences of opinion which might exist when two men measured the same object, because if to suit his purposes he preferred to say it was different, he was inclined to say so. So that there was still the opportunity to get decided disagreements in regard to colors which used physical apparatus but which used it only as an aid to the eye.

In order to get a device then which would remove all possible argument from color problems, it was necessary to get something which did not depend upon the human individual at all. Various attempts have been made to do that. Recently through the development of the photoelectric cell there has resulted the invention of several color measuring instruments. In general these color measuring instruments can be classed as color analyzers and what you get is this sort of thing: If this (illustrating) is, say, in the violet and this is in the

*Presented at the New York Section Meeting, September, 1930.

red, they measure the energy units all the way along and will give you some sort of curve like this, and if you have another color, they will give you a differently shaped curve. If you have less intensity of this same color it should give you the same shaped curve, but it usually doesn't.

When you have a thing that looks like this, the next question that one asks one's self of course is, What does it mean? And right there is where you run into difficulty. It is very much like taking an X-ray picture. I can pass an X-ray picture of a lung, or something of that sort (showing the lung and ribs) around among you gentlemen and I doubt if any of you could determine the degree of pathology. On the other hand, a trained expert in that field may get some inkling of what is wrong. But even then if you give the film to two different experts they may disagree. And that is what happens here. We have a very pretty curve which shows the intensity all the way through, but what does it mean? We don't know. And in order to get that curve in the instruments which are now available you either have to work half a day, or longer, and by that time maybe you don't want to know whether they are the same or not (laughter), or you can take a picture in a minute on one of these devices but you have to wait until the picture is developed and dry before you can look at it. It doesn't always solve your problem at once. And one of these devices has as many as twenty-eight controls and dials, which doesn't make the thing simple to operate. So that these devices are principally useful to the trained laboratory expert and in fact can only be used by such an individual with any success. They are extraordinarily useful for standardizing colors initially.

That is not what we wanted to do. We wanted a device which would give you the answer and give it to you at once, just as quickly as the eye will give it to you. So we scrapped the ideas just mentioned and decided to measure not every individual point, but to obtain first of all a mass effect. What we wanted to know, to begin with, was: Is this color like that one, or is it different, and if it is different, how much so?

The Colorscope then is intended to do just that thing: to tell you whether two colors are alike or different, and how much.

That was the first thing we did. I am not going to say what we did after that until a bit later. But if we take two reds and put them in the Colorscope, turn the switch on and make the necessary adjustment on one dial (and only one dial) we can tell you whether they are alike or different, and how much.

The problem that is probably in your minds is, On what scale is this "how much" measured? It is measured on a scale of practical experience. As the result of having numerous pieces of cloth dyed for us, some of which were said to be alike commercially by expert eyes and some of which were one shade apart, we have so set the Colorscope that three divisions to the right means that it is one shade too dark, and if it goes beyond three divisions it is not acceptable commercially; three divisions to the left means it is one shade too light, and beyond that it would not be considered a satisfactory commercial match.

That has been set as a standard on the basis of experience. We could have set it six points or seven points or eight points. In other words, we can increase the sensitivity if it is desirable, but we found that the sensitivity was sufficient at that point and we preferred not to go any farther. It is quite easy to see three divisions. You would not get the same accuracy if you made it less. It is doubtful if you would get any greater accuracy by making it larger.

The result is then that we can tell whether a match is acceptable or not, and as I say that is based on experience only, by measuring a large number of pieces which were dyed and which were considered acceptable by experts. In other words we have put the thing not on any artificial basis but on the basis of actual practice and actual practice is what governs trade.

The next problem that you might want to know something about is this: Suppose you find they are not alike, they are not acceptable commercially, these two reds. What is the matter? Have we too much blue? Have we too much red? Have we too much yellow? What is it that is wrong?

The answer to that is easily obtained by placing in front of the sample a color filter. In general three color filters are all that is necessary. This represents (illustrating) the length of the spectrum from here to here. We have one color filter which takes that region alone. If we put that color fllter in front of the sample we are measuring then only the red. Everything below this is cut out. And if we find a difference in the red, we know at least there is too much or too little red, whichever it may be. Then we will take this section of the spectrum, in the yellow and yellow-green, and we will measure that. Possibly in our samples we will find that there is no difference between the two in that respect. Then we will come down here to the blue end, with another filter, and measure that, and determine how far off the blue is. It is very simple to do. It requires three observations in addition to the first one which was required originally.

There is also a place on the machine to determine the difference in color in the dyes, and in some cases it is possible, instead of using our filters, to use the actual dyes which you are using on the cloth. One may use those as filters, in the case where the dye transmits its own color.

It also becomes possible in a way we will describe later

to take a sample which is unknown and by means of these filters determine how it is made up and therefore how it can be reproduced.

Some have objected that this device is not like the eye because photoelectric cells look at the samples and it is a known fact that no photoelectric cell exactly duplicates the curve of sensitivity of the eye. The answer to that is that the photoelectric cell is so much more sensitive than the eye that the curve of sensitivity is above that of the eye for any color. So that if the eye sensitivity is like that (illustrating) and the photoelectric cell sensitivity, say, is something like this, it doesn't matter because we are higher up in any case, so we have greater sensitivity than the eye at any point.

Another question that has sometimes been put to us is this: If it matches in the machine will it match in daylight? The answer to that again is, Yes, because the intensity of illumination which we use is much above that of ordinary daylight in any color, just as the sensitivity of the photelectric cell is above the visibility curve of the eye for any color. So that with our high sensitivity in the photoelectric cell and our intense illumination we have never yet failed to find a perfect match in daylight if it matched in the machine. If there is any question about that, if there is any feeling that that may not be so, then it is only necessary to slip in these filters and measure in different colored lights, and if the color of the two objects is the same with these filters then it must be the same in all kinds of light. So that we can avoid any possible argument if one is particularly critical on that score. But that is not necessary in ordinary routine measurement.

If one wishes to measure smaller regions of the spectrum than this, filters can also be provided for that purpose.

I mentioned at the beginning of my talk the question of weave and sheen. Those are two extraordinarily troublesome factors, as I found out shortly after I started this.

The answer to the sheen question we obtained by using an integrating sphere. If we take two pieces of glossy cloth which are woven the same and turn oue of them around this way and hold the other steady, then the one I move will appear alternately darker or lighter, depending on the direction in which the light falls on it. The answer to the problem is, if you can place on that object perfectly diffused light, the annoying angular reflection or sheen effect immediately drops out. So we don't illuminate our samples in such a way that the light can be reflected from them directly. We illuminate them from all angles, and our integrating sphere looks like this: (illustrating) those two marks represent our two samples and they form a part of the surface of this sphere. We have in here two powerful lamps with a shield in front of them so that no light directly from the lamp strikes the sample. The only light that strikes the sample is that which comes from all portions of the sphere and direct rays are prevented from reaching by means of this shield.

We can thus say we have indirect illumination on the samples. These two lamps are slightly out of the way and the two samples are looked at by means of two lenses which focus the light onto the photoelectric cells.

In that way we find that we can take the most diverse sheens and if they are dyed the same they register the same. The effect of sheen is completely wiped out.

Weave is taken care of in an entirely different way and that is done by rotating the samples. The samples are rotated sufficiently rapidly so that from the point of view of the photoelectric cell they are fused in together. In other words, it is very much like those rotating tops with a number of colored segments. When you spin them you get a color which is made up of all those placed on the surface of the top. The eye is not fast enough to see the different colors. So we take care of weave in that way.

I might describe very briefly what happens beyond this point. I might say that provision is made here to draw air past in front of these samples to prevent any possible change of color due to drying, or to prevent any possible bleaching of the color due to the heat of the lamps during the few seconds that they are turned on.

From here on then we can focus on two photoelectric cells with suitable baffles to prevent light from reaching them from any place except the samples. Then the output of these two cells is carried through a balanced amplifier, finally to a galvanometer, which is an electrical instrument for recording current, and the instrument records the difference.

If these two cells are identical and if both sides of our amplifier are identical, then when we carry this over to the galvanometer, the galvanometer should read zero if the two colors are like. However, electrical instruments don't operate that way. You are almost certain to find some little difference in these two cells. You are practically certain to find some little difference between the amplifying tubes which you place in here, and that is the thing which makes it necessary for us to put one control on the machine. That one control is a compensating device purely intended to compensate for the difference in the circuit itself.

I think I have said enough to give you a general idea of what this machine is like, and we come now to the point of actually showing it to you. Before we do that I want to make—I was going to say "an apology" but it isn't that—an explanation of just how we are going to show it to you. Normally, one works entirely at the instrument. There is a galvanometer you will see on the sloping panel. That is the galvanometer we use, and we

view it with the eye, but you can't all see that. I don't think anyone can see it at the present time. So we have placed another galvanometer on the board that is facing me, and that galvanometer has a beam of light strike it, and the beam of light is reflected up to this large scale on the wall, which replaces the scale on the instrument.

That naturally introduces some difficulty because in order to magnify the motion, to cover this wall scale, instead of covering a scale that I could span with my two fingers this way, we have had to introduce increased sensitivity and consequently when we do that, when we magnify it to such an enormous extent as we are doing here, we introduce some unsteadiness. Also, we have it placed on a table here, which is on the floor, and the motion of the audience may give it some little vibration. The needle is suspended by means of a fine fiber, whereas our normal galvanometer is a pivoted instrument. Vibrations in the room will have an effect on the Colorscope but they may not on this other instrument. It is just the difference between having the hands on your watch pivoted and having them hung up by a hair. You can easily imagine what a difference you would get in a case of that kind. So that we are working under a very considerable disadvantage in order to give you the opportunity to see the entire operation on the screen.

Very often as an infant grows up in life the stage is reached where its parents know less about it than anybody else and that may be already beginning to happen in the case of this Colorscope. I will introduce to you Mr. Milton Gluck who has made many practical tests with the machine and who has investigated at great length its industrial use in the field of textile dyeing and bleaching. (Applause)

Mr. Gluck: Mr. Chairman and Gentlemen: Being called to demonstrate the Colorscope directly after Dr. Sheldon has spoken puts me in mind of something that was attributed to Napoleon. He said upon reading his history book that the men in it could be divided into three classes: those who were born great, those who achieved greatness, and finally those who had greatness thrust upon them. In speaking with Dr. Sheldon and addressing your society I feel that there is no question about my belonging in that last class. (Laughter)

From my observations of the machine in commercial application I should like to demonstrate and show you in a general way how readings are taken on it and color determinations made.

There really is so much that could said that it would be quite impossible to cover it all in one evening's discussion. For that reason I should like to point out what I consider its first significances, and then in a general way mention how those facts can be applied to individual work.

Let me say, first, that we are not dyers here and I think Dr. Sheldon will agree with me when I say that our job is not to show dyers how to run their business. We don't attempt to know about the technique of dyeing materials. What we have is an instrument which shows the relation between two colors and it is offered simply as a scientific development for what it may be worth in that field. The dyer's problems are so intricate that we cannot attempt to solve them all, and then, too, they change every day, for when new colors come up there is a new set of problems to work with.

The first thing that strikes me as important about the machine is that the human element doesn't enter into it. You put two colors in, press the button, and the needle registers a certain number. No one has to use his eye, no one has to use his judgment; and no one has to say, "Well, am I feeling right today?" or, "Am I in good humor? Am I going to let all these colors pass, or jump on these fellows who tell me it is all right?"

I think it was Professor Redde of Oxford who pointed out that a man's sensitivity to color is determined by the amount of oxygen in the arterial blood stream. Whether that is so or not, we all agree that each man sees color differently. When Mr. X will see it differently than Mr. Y who is right? The point I want to make is that measurements are made on the machine, without the human element entering into it.

Another thing: it doesn't depend upon the time of day. We can judge at night as we can in the daytime. We can receive the same reading on the machine in January as we do in June, or whether it is nine o'clock in the morning or twelve o'clock at night, whether we have north light or whether it is a cloudy day. The question cannot come up as to whether the walls in the room would affect the color value, or whether a red brick wall or a yellow paint wall will affect a man's judgment.

None of those things enter into the reading on the galvanometer of the machine.

Another thing: if we can check dyed samples it is also possible to check raw materials. We can put a dye powder in the colorscope and see if it is the same color as the last shipment we received and since we can make our readings a little bit more sensitive than the eye we can make absolutely certain that our color is the same as it was last time. Or we can see the effect on cloth of that color. If we dip a piece of cloth into a standard solution we can find out if we are getting as much color value per dollar expended for dye as on the last shipment.

Finally, and here is a point that has just occurred to me: Suppose a man were unscrupulous enough to want to return goods because the price had dropped; he may give the excuse that the colors don't match, that they are not up to standard, and he calls in some friends of his who want to aid him, and these fellows also say that the colors don't match. If those colors do match the machine will show it at once and there will be no question about it. So when the dyer works hard—and heaven knows

he puts in enough time on his job—and produces good work, this machine will show that his work is good and will defend his work and his ability in producing a match.

Suppose now that I show a few of the things that I think will be of interest to you in the actual handling of the machine. I am going to take some white paper, although we could take white cloth instead, and put it in the machine and balance the machine. We say the machine is balanced when the spot of light points to zero and that of course means that the galvanometer needle also points to zero.

When those two whites are balanced, as we say, I will change one of them with a pencil by putting a tiny dot in the center of one of them. The object in doing that is to show you the difference between pure white and a tiny dot on it, and so make plain the sensitivity of the instruments.

You see, due to the fact that we use a wall galvanometer the swing is rather slow. On the machine the needle which is pivoted on snaps right into place and points to zero or one or two or four. The needle now points to zero.

I am going to take out the paper on the right side of the instrument and place a pencil dot on the center of it. This dot I would say is about one millimeter or one and a half millimeters in diameter. That is about one per cent of the surface of this paper. As I hold it up you can see the dot quite plainly because the black in it is concentrated in one spot, but if this were diffused and spread out over the surface this one per cent change would be very slight and hardly noticeable. As the Colorscope sees it it could just as well be spread out all over the surface, instead of putting it in one spot where you can easily see it. If I put this back in the machine and the machine weren't sensitive the zero would still point to zero when the current was put on. If the machine is very sensitive it will cause the needle to swing very definitely to one side. (Demonstrated) You see, it swings seven points directly to the right, which means dark. The left means light. That means the dot has had a pronounced effect on the sensitivity of the machine. In other words, one per cent will bring it directly to the right.

Let me mention one other point that I think will be of interest. When colors are dyed they are often finished afterwards by a machine that gives a little bit more effect on one side than it does on the other. Sometimes that effect produces a reddish sheen or a red tint that it doesn't produce on the other and carefully trained and sensitive eyes can distinguish that at once.

I am going to take some cloth that I will pass around afterwards for inspection, and put it in the machine and balance it. Then I am going to turn one of the pieces of cloth around and see the effect on the other side. If the other side is the same the galvanometer will point to zero. If it is light in surface effect the needle will swing to the left, and if it is darker, it will swing to the right.

This is the cloth, on which I have cut some little circles, and I will pass this around as soon as the color determination is made. In other words, the finish on one side may be a little different than the other. I understand that is due often to the effect of rollers that are hot on one side and less heated on the other side, which produces a different effect on the dyes in the cloth. The needle now points to zero. We will turn one of these samples around and just measure the other side. It swings six points over to the right side and shows a pronounced difference. That difference is rather hard to see in this evening light but I think in daylight it will be quite pronounced.

If we put the sample back in the machine on the first side the needle will point to zero again. In that way we can check our machine and see that it is right. This is the original side now and our needle points to zero.

The question has come up as to the difference in measurements between light colors on the one hand and dark colors on the other. If our machine is so good on whites and light pinks, sky blues, and so on, how will it work on blacks, which as you recall are way down at the bottom of the chart and have the lowest intensities? For that reason, I am going to show you the difference in some black cloths.

Here are two blacks which may be alike or may be different. We are going to ask the machine to say whether they are the same. It is rather hard to see in this electric light. Perhaps some will discern a little reddish tone to one that the other one doesn't have. Our demonstration will show whether these two are alike. If they are not alike it will show whether one is lighter or darker than the other, how much lighter or darker, and then how we can correct one to make it equal the other.

We are first going to put our two samples in the machine, which are cut from this piece called the "standard." We cut two pieces out of the standard and put them in the machine and then we adjust our machine to show that they are alike by bringing the needle to zero. (It points to zero)

Now we will remove the one on the right side and put in this one which we question. If this one is the same as the other the needle will remain at zero. Observe that it swings off twelve points to the left however and that means that this one is so many shades lighter than that one. We will check our instrument now by putting in our original piece again and the needle will return to zero. (It returns to zero)

The dyer will say, "Well, that is all very well. You have shown us that it is lighter than the other, but what are we going to do about it? How are we going to correct it? That is all right for the salesman and the customer to know it doesn't match. But what are we going to do about it?"

Let's see how that difference is made up.

Suppose now we consider the red element of this dye and see if one is really redder than the other. The way we do that is to insert two filters into the machine so that the light that is reflected back from these samples will first pass through the filters. When I put two red filters in, it permits only the red content of this black dye to shine through. I will now insert these red filters in the machine, which will only measure the difference in red lights of these two samples. We will put the filters in and now balance with our standard. (The needle points to zero)

This shows that the two pieces cut out of our standard are the same as far as the red content of this dye is concerned, which we know to be so because the pieces are the same color.

We will now put in our X sample, that is, the sample we are not sure about and will see whether it has less red or more red in it. If it goes to the right it has more; if it goes that way, it has less. The needle points seven points left. It has less red in it, seven points less red.

We know that we have a deficiency of red. Let's see now if we have a deficiency of blue. We will put two blue filters in the machine. It goes to the left—about four and a half points. In other words we need red to make up our sample and we need blue and we need half as much blue as we do red.

Now we will take a yellow-green filter to cover that particular section of the spectrum. It is just a little off in the yellow-green section, three divisions.

So that the conclusion we get is that the colors don't match. We are twelve points too light. Three points is a shade. So we are four shades too light. And the reason for that is because we are lacking in red, we are lacking in blue, and we are lacking a little bit in that yellow-green color.

In this way it is possible to determine very quickly—of course much more quickly than we can by switching that machine over to this wall galvanometer—whether two colors match; if they don't match, how we can correct one to make it equal the other.

Here is an interesting point: when I used this filter I said we were lacking in red, and I meant this particular red. It may not be the red the dyer is using, and if he pours a transparent dye in these cells it is possible to use them as filters. We have noticed this about using these liquid cells as filters: they can be used, first, only with transparent dyes, and then when the reflected light of dyed material gives the same color as the transmitted light. If we use these liquid containers as filters and pour in our standard red solution, and take our reading, we find that we go five points off on the galvanometer. If we add two ounces, we go ten points off. If we add three ounces, we go fifteen points off, and so on.

So it is possible by our galvanometer reading to determine in a general way the amount of dye to be added to a solution. In other words we can take our readings through the transparent dyes, using them as the filters, and so calibrate our machine in terms of units of dye strength.

I should like to say in that regard that it is not the desire of Professor Sheldon, if I understand him correctly, to work out a calibrated scale for the machine, but to have each individual calibrate it to his own particular requirements. In other words, a man may be using this type of red dye, or that type. By putting his own filters in, his own cloths, he can readily determine just how it should be calibrated to his particular use.

In general, I might just mention that the function of the machine is to show whether colors match, to show the relation between two colors, that is to show the relation between white and a complex color so one may see how a complex color is made up—to show how one color formula may be corrected to equal another—and that may be done by means of glass filters or by means of liquid filters; and in general to give not only the man who wants to remove the human element from color judgments a mechanical instrument, but to add to the equipment of the research chemist a machine that he can use for the investigation of the science of color and for the development and the discoveries of the great future of the dyeing industry and of this association. (Applause)

Chairman Gaede: We certainly are very grateful to have such an explicit explanation of the methods and use of the Colorscope and to have it brought to us in such a manner that we can understand it. There is no doubt that some of our questions in connection with it have been answered but some of us may still have some questions which we would like to have answered, and I am sure Dr. Sheldon and Mr. Gluck will be glad to enlighten us.

Dr. Sheldon: I should like to point out, Mr. Chairman, that there is one thing we have overlooked and that is the possibility of measuring the colored powders. I think Mr. Gluck overlooked that.

We have little containers like this that are used if you wish to measure the dye in powdered form. You merely take off this cap, place the dye in here, put the cap back on again, so as to get a continuous surface of dye upon this front face, and put this in in place of the samples of cloth. In that way you can measure powders as well as liquids or textiles.

That is the only thing I can add to what Mr. Gluck has said.

Chairman Gaede: Are there any questions?

Mr. Chase: Mr. Chairman, there is one thing that I imagine is in the minds of most of us here and that is what is frequently encountered in the dyehouse, the matching of a silk sample or a rayon sample against a cotton sample. I imagine that in some way the sheen and weave

take care of that but I think perhaps a little more information on that subject would be of interest.

Dr. Sheldon: You have really answered your own question.

We have eliminated both weave and sheen. We have one other factor however that sometimes comes in there and which you may possibly stumble into in operating the machine and that is thickness of cloth samples. But personal experience in operating the machine will overcome that difficulty. You see, these samples are backed up with a little plunger here which is black on the surface. If your sample is very thin, the light may go through the sample, strike the back, and come out again, in which case you get some effect of the background. If you were measuring a thin silk against a cotton that would be troublesome or if you were measuring two silks it would not be because the same background effect would be on each. If you were measuring two cottons it wouldn't bother you because the same background effect would be there, the same absorption going through the cloth and back. If you were measuring a silk against a cotton, the background effect would be liable to come in and cause trouble.

The way to remedy that is to put in sufficient thickness so that the background effect is completely wiped out. Usually two and at most three or four disks are quite enough to wipe out the background. If you question whether you have wiped out the background or not, put in one more piece, and if you get the same reading you have wiped it out. If you don't get the same reading, you haven't.

So you can tell at once whether that background effect is bothering you or not. That is the only thing you might get into trouble with in silk and cotton. The weave or the sheen will not bother you.

Does that answer the question?

Mr. Chase: I see the point.

Mr. Howes: I should like to suggest that the Chairman ask to have some of the samples that he has in his pocket checked up by the machine. (Laughter)

Chairman Gaede: That is a matter I was going to bring up later: I think others may have some questions to ask first. Later on some of us perhaps have some samples that we will want tried out.

Mr. Schaumann: Mr. Chairman, I should like to ask if there is any provision made in the machine for measuring the tinctorial power of one dye against another. Take two blacks, for instance, one a reddish one, another a greenish black. The question arises: Are they the same strength? Have they the same tinctorial power?

Can that be decided?

Mr. Gluck: I can't answer that with a simple, "Yes," or "No," because I am not quite certain what the questioner meant when he said "tinctorial value." If you put in a red black and a green black of course they won't match on the machine. On filters, one will show that it has more red and the other one will show that it has more green or less green, as the case may be. You can measure the affinity of dyes, that is, what might be called their tinctorial value, by dipping the cloth into the dye, and seeing how dark it registers against the standard sample or against anything else that is placed on the other side of the machine.

Is that what you meant by your question?

Mr. Schaumann: No, that isn't quite what I meant.

For instance, take one individual dyestuff, and let's say you make a five per cent dyeing of it. Would your machine show that difference, and how can it read it?

Mr. Gluck: You mean, can the machine show as much as a one per cent difference?

Mr. Schaumann: Well, that is larger than a one per cent difference. If you take five pounds we will say of a dyestuff, color one hundred pounds of material, and then take six pounds of the same dyestuff and color one hundred pounds of material, that gives you a strength difference of between five and six per cent. Will that machine indicate that and how will it be shown?

Mr. Gluck: If the eye will show one shade difference between the two dyed samples the needle will swing three points. If it shows two shades difference, it will swing six points. If it shows no difference, it will show something less than three points. The sensitivity of this machine may be increased, but if you want to go a little further than the eye does—let's assume that the eye doesn't see any difference there. I don't know whether it would with those particular dyes. We can increase the sensitivity and instead of reading three points for a shade we could read six or nine, or whatever figure we decided upon. So that if the eye can see a shade difference between those two it will immediately register on our galvanometer.

Mr. Schaumann: On what side would it register?

Mr. Gluck: If darker, on the right, and if lighter on the left.

Mr. Schaumann: I think the increased strength will make it appear darker and make it swing to the right.

Mr. Gluck: If it does appear darker it will swing to the right.

Mr. Low: I think I can make the first part of Mr. Schaumann's question clearer by saying, Suppose you had two greys, one with a greenish cast to it and one with a reddish cast to it. They are decidedly different. They are different to the eye of anybody.

All right. Suppose you take the same dyestuff with which you produced those two dyes, and dye two pieces a very intense black. It is no longer possible for the naked eye to distinguish any difference between those two. However, you know that one of them is decidely on the green side and one is decidedly on the red. But just as they were both the same degree of lightness when they

were grey, they may be the same degree of darkness when they are black. Will there be any way of showing that difference? I imagine the machine would show them as different.

Mr. Gluck: If in the finished cloths there is a difference that the eye could see, the needle will swing further than three divisions. If the eye can't see it it will swing less than three divisions. It will probably swing one point over or two points over to one side or the other, depending upn whether it is darker or lighter. If the eye sees it and it is definitely a shade difference it will swing at least three points, perhaps a little bit more, depending upon whether it is one and a half shades or two shades, or whatever the difference is.

Mr. Schaumann: The thing that isn't quite clear to me is how you distinguish the difference between darkness and shade. You have a correction for shade, but shade is sometimes controlled by intensity of color. I don't understand how you can tell whether the one sample is stronger, as we call it, than the other. I think you call it darker, but we call it stronger.

Mr. Gluck: Of course, these terms "stronger" and "darker" in shade and tinctorial value sometimes have different meanings. What I mean when I say "darkness" is, Is its intensity greater, or is it less? The machine will show that, but to make absolutely certain, if you want a very definite reading, it is only necessary to slip the filters in and take the readings with the filter. Then if one has more green in it than the other it will be apparent at once through the filters.

Mr. Chase: I understand that it might be possible to put a green and red in there, and they would match up without the use of a filter, but obviously they would not be the same shade and the filter would bring that out just as quickly and more quickly perhaps than the eye.

Dr. Sheldon: We have played with the machine enough so that we ourselves know several ways of fooling it but so far we haven't been able to find anything that would fool the machine and fool us also. If it will fool the machine it is so far off that it won't fool us. And I can see that it would be possible by a considerable amount of experimenting to get something that might possibly fool both of us. But I think that the chance of doing that is probably about one in ten million and if it would fool both of us it would also fool the customers so we don't need to worry. (Laughter)

Dr. Roeteli: There are two points I should like to bring up.

What is the definition of a "shade"? Is that based on any particular unit or yardstick, or is that just the commercial way of expressing it?

Dr. Sheldon: Commercial talk.

Dr. Roeteli: One person calls a difference one shade and another three shades.

Dr. Sheldon: In general, the normal eye will see a difference not for three divisions but for something slightly over that, but we placed it at three divisions to be quite conservative. We have been quite conservative in this.

Dr. Roeteli: That is probably an agreement more or less between two parties.

We have a problem that I should like to bring up. We are dyeing silk for the hosiery trade. We think we have a perfect match to a sample that has been submitted and if it is being put in the same gauge of material that will match the sample exactly but if it is used for some other gauge, that is, for either smaller mesh or larger, it will look entirely different than the sample. How is the machine going to correct that? Or can it be used in any way to overcome this difficulty which is absolutely beyond the power of the matching party?

I should like to know how you would go about that.

Mr. Gluck: I think the question can be brought down to this: suppose you are dyeing a four-thread stocking and an eight-thread stocking. Will the machine take into consideration the fact that you have more threads in one stocking than in another?

My answer, after making a determination with stockings, is that we don't want to know that. We want to know if the four-thread has the same color as eight-thread. So if we put four-thread on one side and eight on the other and they balance it means that the color value of the two is exactly alike.

Dr. Roeteli: That answers part of my question, but where you use different mesh, it will show differences. We have had the problem of having to match a shade in a different mesh than the sample submitted. That is something we are unable to do now.

Mr. Gluck: Carrying out this idea a little further, I might say that if the color value is due to the tiny little shadows that the threads cause in their weave, those are balanced out by the rotation, first at one angle, then at another. But if that weave is so completely different that it gives a different effect in the cloth, then our object with the machine is to make those two match. And if the machine sees them and registers them alike then they will look alike to the eye. If the machine registers them as being different, they will look different to the eye.

Chairman Gaede: I think Dr. Roeteli means that there are times when you take a lot of skein silk and knit stockings of different gauges, for instance a forty-five gauge stocking and a thirty-nine gauge stocking, and to the eye they will appear different. And it is necessary to dye for one gauge stocking a different color than you would for the other, in order to produce the same final result to the eye.

What would you do in that case?

Mr. Gluck: My answer would be this: that if you change those dyes so they look alike to the eye they will look alike in the machine. The machine shows two samples to be alike, and they are alike to the eye. And if the combination of threads and dyes in one gives a certain effect on the eye that another combination of threads and dyes gives, then the total of one and the total factors in the other will be even so they will register equally on the eye. Of course if we have more dye and less threads or less dye and more threads, both producing the same effects, they will produce the same effects on the machine also.

Chairman Gaede: Does that answer your question?

Dr. Rocteli: Yes.

Mr. Chase: I hate to monopolize this discussion but here is a real problem which I think will take a lot of explanation. In dyeing fabrics composed of more than one fiber, take, for example, cotton and rayon, where it is necessary to dye both fibers to the same shade, it might be possible to put we will say five per cent total color (call it black) on the fabric. It might be that the entire five per cent goes onto the cotton, leaving the rayon white. On the other hand, two and a half per cent might go on each. You would have a totally different effect in that case. But as near as I can see it, the machine would be bound to show just as much intensity of color in either case, although to the eye they would appear absolutely different.

For example, as you made that dot on the white paper you made it right in the center. You said that it might have been spread over the paper. Well, now, on the fabric, you might have the black on only the cotton threads, whereas the rayon threads would be white. It would be a very difficult thing.

Mr. Gluck: I might say if we have a mixture of two colors in the cloth. like a weave of rayon and cotton, and the rayon is a different color from the cotton, we can't measure them separately on the machine. We can only give the total effect of those mixed together. If we have a design woven into the cloth and we cut out a piece of cloth that is part of the design and part of the background, we can't measure them separately. We can only give the total effect of a solid mass.

Dr. Sheldon: I might point out a rather interesting case of that sort that came to our attention.

A clothing manufacturer came to us with a rather unusual problem. His problem was what he called matching linings to the suiting material, and he wondered if there was anything on our machine that would help him. Frankly I didn't know. He showed me some suiting materials which had all kinds of colors in them, decidedly red, blue, grey, and a lot of things, and then he showed me the linings they used for them which he considered to be a pretty good match. The lining was a flat color. It wasn't a mixture of threads.

I put the lining on one side of the machine and the suiting material on the other side, and it was about twenty-five points off on the machine. In other words, mixing up all the colors that went into the suiting gave something of the same effect of the flat color of the lining.

Then he said, "I have one that I think matches better," which was in this case a green lining, and it came to about fifteen or eighteen (somewhere around there) points different.

"Well," he said, "we consider that a better match." He said, "I will tell you now what this next one will do."

He produced a third suiting, all kinds of colors mixed into it, and the lining and he said, "I think from what you have gotten already that you ought to get about ten on this."

It was off about eleven and a half points. In other words, he really did have a good match as the eye saw it. If you took the two materials and went to the back so that the eye couldn't pick out the individual red and blue threads, they looked alike, and that is what the machine said. Apparently what he was trying to do although he didn't know it up to that time, so he said, was to get linings that would look like the suiting materials at a distance, the linings being flat colors and the suitings having various threads woven into them.

Does that answer the question?

Mr. Chase: No. That is a good application of the machine but it is entirely different from what I had in mind.

Chairman Gaede: In that case you might have to separate the threads where it is necessary to get the two kinds of fibers. That is what you mean: get the two kinds of fibers to match the one sample. Isn't that what you meant?

Mr. Chase: Yes, something of that sort. The eye would see it in an exaggerated case such as I gave, but when you get down to practical work you might get only a very slight variation between the shades.

Dr. Flynn: Suppose we had a piece of white cloth and the same fabric dyed red and it was put in the machine. Would the red register more than the white? (Laughter)

Chairman Gaede: Do you get that question, Dr. Sheldon?

Dr. Flynn: Which would register the most red in the machine, the white cloth or the sample of dyed red?

Chairman Gaede: The dyestuff or the dyed sample?

Dr. Flynn: The white cloth or the cloth dyed red, measured through the red screen—which would measure the most red?

Mr. Gluck: I think that the red cloth will show much more red than the white.

Dr. Flynn: How can it do that? The white cloth reflects more red.

Mr. Gluck: Would that be like comparing it with black? And would it show more red than the black one?

Dr. Flynn: No, just take the red cloth and the white cloth. Which reflects the most red?

Mr. Gluck: Well, I must answer, I don't know.

Dr. Flynn: You know that white cloth reflects more red. If its whiteness is 100 per cent it reflects all the red that falls on it, and anything that you put on there cuts down not only the red but the other portions of the spectrum.

Mr. Gluck: The point is that the side to which the red cloth swings the needle we have named dark. But suppose we do this after the meeting and see how it works.

Dr. Flynn: All right, I would like to see you do that.

Mr. Puller: If we have a mixture that produces a brown and this same mixture is reproduced over again, using different dyestuffs, those different dyestuffs would show a distinct difference in the machine, but dyed on the material they would be identically the same. Would the machine show that?

Dr. Sheldon: If they appear the same to the eye they will appear the same on the machine. Of course if you use the filters you will get a difference.

Mr. Springer: I should like to offer a suggestion in regard to that red and white. In regard to that white cloth, theoretically when we see white, isn't that because we see a reflection of the primary colors on the eye?

Dr. Sheldon: Yes, I think so.

Mr. Springer: Therefore, there must be enough blue and yellow, that is, taking it for granted they are the primary colors—I know they are not—as regards the eyes, taking it for granted there are enough of these primary colors to compensate the red. In other words, we see just white, and in the case of the red there must be an excess of the red over these other primary colors to show red to the eye.

Dr. Flynn: Look at the white cloth through your red glass. It looks redder than the red cloth looked at through the red glass. Take any of these little toy spectacles and test that out. You look at a certain design through the red spectacle and the white part of it looks redder.

Mr. Springer: What would be the theoretical explanation for that?

Dr. Flynn: The red filters cut off the other colors, but the actual amount of red reflected is greater from the white than from the red surface, which really is not transparent. It really suppresses not only some of the red, but all the other colors as well.

Chairman Gaede: I think the only way to answer that question is to put it to the Colorscope and let that give the answer.

Mr. Sera: Mr. Chairman, in one batch you have a chiffon stocking and an eleven-thread. If you dye them both the same, at the same time, the chiffon stocking will look red. Would that show up in the machine?

Chairman Gaede: Will you please repeat that?

Mr. Sera: An eleven-thread stocking and a chiffon which is a four-thread are dyed together in the same batch. When they are dry, the chiffon stocking looks red. Still they were both dyed in the one machine. Would that show up in that machine?

Mr. Gluck: I think the answer to that question is quite plain. That is, if you produce the same effect identically in both the machine will register them the same. I mean by that if you take a batch of wool and hold it in your hand, colored wool, and look at it this way (indicating) and then press it together so it is very tight and concentrate that color in one place, it will look different. So there are several factors that we take into consideration in color value. One of them is the number of threads to the square inch of weave or the amount of wool we hold in our hands, when we squeeze it together and put more threads in a certain space it looks darker because we have concentrated our color. Spread it out and it looks lighter. And if those things look different to the eye the machine will show them different but if they are the same the machine will register them the same.

Mr. Dohan: Take a piece of wool and dye it with a straight color, a violet, and turn around and match that color with a red and blue, so exactly that the machine won't show a difference of three points. Will it be possible to tell whether that material is dyed with two colors?

Mr. Holland: I can answer that question. I have had one of these machines in my place for about two weeks, over in my laboratory. Mr. Puller asked the question before. You take a brown made out of red, black and yellow; take a brown made out of yellow and black or orange and black, and dye the two pieces of goods up, put them in the machine, and it will show an identical match. If you put the powder in the Colorscope however, it will show a great difference.

Mr. Dohan: That is not the question.

Mr. Holland: If your eye would show the same color—

Mr. Dohan: Take this dyed shade that has been dyed with straight color. Put that in the machine, and put

in another match that is so close that the needle won't show a three point difference, say a dye made with red and blue, to match that violet. Will the machine show it has been dyed with two colors?

Mr. Holland: If you use the filter it will, but not without the filter.

Mr. Dohan: The difference is one of less than three points. How will the filter show it? The match is so close that the needle won't move three points. How will the filter show that?

Dr. Sheldon: It may be way off on red. There may be a lot more red in one case than in the other but—

Mr. Dohan: But a combination of red and blue match the violet, to the naked eye. The machine won't pull more than three points. You take it for granted then it would match the color.

Dr. Sheldon: That often happens. On separate colors you will get a different result than on a combination.

Mr. Puller: Mr. Chairman, as you know very well, you may have a shade or more of brown that appears the same to the eye in daylight, but when you strike that match and look at it under the artificial light there is a distinct difference. How much will the machine show that?

Chairman Gaede: I was wondering about that same point myself.

Mr. Gluck: Through the courtesy of one of the members of this organization, we have had our machine at his plant and made some tests, and I have drawn this conclusion from what they have said—they didn't say this directly but this is the impression I got—that a match is not considered a good match unless it matches in all lights. If it matches in daylight and is all off in artificial light that is not considered a good match. The difference between daylight and electric light is that in one we have a little more blue than in the other and a little less yellow.

If our samples match in the machine on the first reading under direct light and then match with the yellow filters, red filters, and blue filters, that means they will match in any light, that is, any combination of reds, blues or yellows or any mixture of daylight, artificial light or any other light. So if we have a match that will match on all filters it will match in any light at all.

It is also possible to obtain a filter called a daylight filter in which you can see the effect of daylight alone without taking into consideration any other filters.

Mr. Sera: Would the filter show any more red in the fine hose than it would in the eleven-thread? They are both dyed the same.

Chairman Gaede: That is rather a technical question. You may have to make it a little more explicit.

Mr. Sera: As I said before, to the naked eye the chiffon hose seems redder than the eleven-thread. If you use a filter will it show it redder than the eleven-thread? Will the chiffon show up redder, both dyed in the same machine?

Dr. Sheldon: So far we have found that whatever appears to be the case to the eye is duplicated by the machine with greater sensitivity. That is our object: to make the machine replace the eye.

Mr. Lawrence: There are some dyestuffs for dyeing fabrics that are composed of cotton and wool, and in order to get a uniform shade throughout, say on a green shade—there are four colors used, direct yellow and say a direct blue, and acid yellow and acid blue. Is there any quick way of detecting the acid and direct colors by that machine? (Laughter)

Chairman Gaede: This is a mechanical device. But you may be able to work that out by using the cells—I suppose the dyestuff cells—to compare your various colors on there, to see which color there is more of than the other. Is that so?

Mr. Lawrence: What I mean is if you are working in a laboratory and you get an unknown sample—you don't know what is in that sample and you want to make a quick test. Instead of running your dye and dyeing up—you don't know what it is—you dye first on the cotton, and then you will take a union to see the effect. What I mean is, Could you make a quick test on there to see if there are acid and direct colors?

Mr. Gluck: I might say at that point that we can't do everything, and still there is a lot about the machine perhaps that we don't know. I know there is a lot that I don't know. There might even be something that Dr. Sheldon doesn't know. (Laughter) And there probably is a lot of study that can be done in regard to those machines. That is one of the things we will have to study and investigate.

Mr. Carter: Very often when you are dyeing thread, when you take it out of the dye bath, it will look all right. You will take it down after it has been dried and spool it up and it will show a decided streak, in spooling. That is probably not due to taking dyestuff off the thread. If you put that in the Colorscope to match to a sample, am I correct in assuming that, say, a small amount of lighter color which would be present forming the streak, when turned over or rotated with a darker color, forming the base of the shade, would blend in order to make a total lighter shade than the sample, and that that would be detectable? You see, you would have only four or five per cent of your total sample light, and when you spooled it, maybe out of fifty threads only three or four on a full spool would show up light. If those three or four are rotated will the whole shade be reduced and be apparent in the Colorscope?

Chairman Gaede: I think that was shown by the dot on the paper, where you had about the same effect. It gave the paper, after the dot was placed on it, the effect of being a very light grey, the whole paper, and I think that the same thing would occur in the spool. Is that right?

Dr. Sheldon: I think that is the answer.

Mr. Kingman: May I ask a question which is away from the textile end of this?

If you are testing powders, pigments, you get the surface effect the same as in a print or a coated paper. Is there any way that you can use the original constituents, the original powders, insead of the transparent dyestuff solutions? That is, can you get reflected light from the powders to show what the color would be made up of?

Dr. Sheldon: That is taken care of by these little pill boxes which have the glass fronts. The backs can be taken off and the backs screwed up against the face.

Mr. Kingman: If you had a surface colored with a mixture of powders, instead of a mixture of dyes, then could you take reflected light from those constituent powders and analyze the combination the same as you do the combination of dyes?

Dr. Sheldon: Yes.

Mr. Kingman: By reflected light instead of transmitted light?

Dr. Sheldon: Oh yes. It works equally well by transmission or reflection.

Chairman Gaede: Take certain dyestuffs which are green perhaps when dyed on fiber, but the powder is black or very dark grey. Would that powder show green?

Dr. Sheldon: No, that would show black.

Mr. Holst: What will this machine show in the case of fluorescence?

Dr. Sheldon: I don't think we can do anything with that.

Mr. Jones: I believe it was stated that if a company got a shipment of dyestuffs and that shipment was running out and they received a further shipment, the two could be tested against each other, that is, the powders could be tested against each other to see if the company was being cheated, that is, as far as shade and strength is concerned. Why wouldn't it be possible in a case like that, supposing the first one was a pure dye with a fast color and a very expensive dye, for the dyestuff manufacturer to send along a mixture of different colors, of cheap dyestuffs that would give the same shade with the powders? Wouldn't they show up the same on the Colorscope?

Mr. Gluck: If you put two powders in that are exactly the same color the machine would show them to be the same. But if you dye cloths with it and the cloths give different effects, the machine would give an altogether different effect.

So I suggest one way of testing the dyestuff would be, first, to test the color of the powder, to make sure it was the same and then dip a piece of cloth in that solution and see if it gave the same results as cloth dipped in a solution of the last shipment.

Mr. Jones: Wouldn't it be possible in that case to have the mixture dye the same as the original sample and look the same in the Colorscope, and yet they might be entirely different dyestuffs as far as fastness is concerned?

Mr. Gluck: That depends upon what you want to know. If you want to know whether the powders are alike, if you want to see whether the colors of the fabrics are the same, you put in the fabrics. We can't say that by putting the powders in the machine, when you dip cotton into a solution of the dyes you will produce such-and-such an effect. All we test is color values which you put in the machine. You can test the color values of powders, cloths, or liquids. We can't say from the test of one of those what the other two will be. Each test will have to be made individually.

Mr. Schaumann: I would just like to say that we have been stressing the value of the colors of dyestuff powders. Successive batches of dyestuff powders of the same color all vary in shade, although they will dye up probably to exactly the same shade. Dyestuff manufacturers very seldom attempt to match the shade of a powder of a different batch, because it really has no bearing on the ultimate result when the dyestuff is used on the fiber.

Chairman Gaede: If there are no further questions, before we proceed to trying various samples on the machine, I think there is no better way that we can show our appreciation than by giving Dr. Sheldon and Mr. Gluck a rising vote of thanks.

. . . A rising vote of thanks was extended . . . (Applause).

The meeting adjourned at ten-forty o'clock.

FUTURE MEETINGS OF THE COUNCIL AND RESEARCH COMMITTEE

Council Meeting in New York October 24.
Research Committee Meeting in New York October 24.
Council Meeting in Boston November 21.
Council Meeting in Chattanooga December 5.
Research Committee Meeting in Chattanooga December 5.
Annual Meeting in Chattanooga December 5 and 6.

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ASSOCIATION BADGES

The lapel button badge illustrated herewith is worn by members of the American Association of Textile Chemists and Colorists.

The three "rings" are enameled in red, yellow and blue, respectively, and the initials and border are brought out in gold. The general effect is exceedingly attractive.

Badges may be secured at $1.50 each by addressing the Secretary.

ALEX. MORRISON,
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Andover, Mass.

AMERICAN DYESTUFF REPORTER

SAMPLE SWATCH QUARTERLY

Devoted to the use and application of dyestuffs and the mechanical equipment incidental thereto.

LOUIS A. OLNEY
Professor of Chemistry and Dyeing, Lowell Textile Institute
Directing Editor

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October 13, 1930

MAINTAINING RESEARCH

RESEARCH in the United States as compared to research in Germany is an interesting study, especially when one considers the results to the industries of each country.

Germany for many years has been looked up to as a leader in scientific research. There can be no question but that Germany owes her success in the chemical industries to the work of her research chemists in building up and extending the bounds of scientific knowledge. Research over there has always been of primary importance. Until recently nothing has ever stood in its way. Funds have been, until now, more than adequate. However, the post-war period has so diminished the supply of available capital that research had to be seriously curtailed. Today Germans speak of us with perhaps just a note of complaint; they accuse us of stealing "their thunder"; in other words they think we are now carrying out their research policies and doing a better job at it than they did. They excuse themselves by saying that we have a great deal more money with which to work.

Assuming that the Germans are right, we then have a situation which our chemical industries cannot afford to neglect. We are now giving Germany a kind of competition which heretofore they have not been forced to meet. We have met them with their own weapon—research—and we have proven our ability along that line. More than that, we have become the greatest chemical nation in the world. Now is our time to prove our supremacy.

Should we, too, curtail our research activities, we would probably be doing just the thing that would make us "one of the greatest chemical nations" instead of "the greatest." There is no doubt but that it requires considerable courage and foresight to continually lay out large sums for research from which profits may be considered more or less as an abstract quantity. However, it is only by showing such foresight and courage that our dominance of the industry can be maintained.

The period of depression through which we are now passing should do much to test the enduring qualities of our industry. If our research goes on without interruption, and better still, if it increases, our position as the greatest chemical nation of the world should be assured.

FOR IMPROVED LIGHTING

A REVISED American Standard, "Code for Lighting Factories, Mills, and Other Work Places," has just been approved by the American Standards Association following its approval by the Illuminating Engineering Society, which took a leading part in the development of the code. The code, which applies to practically all industries, is intended as a guide for factory owners and operators in their efforts to improve lighting conditions in their factories, and also as a source of authoritative information for bodies preparing safety regulations. It contains sections on measurement of illumination, recommended levels of illumination, avoidance of glare, specifications of adequate wiring, locating switches, and a suggested minimum regulation to be established by state authorities.

Good lighting plays an outstanding role in industrial economy, the introduction to the code states, some of its results being reduction of accidents, greater accuracy in workmanship which results in improved quality of goods, increased production, greater contentment of workers, greater cleanliness, more order and neatness in the plant, and easier supervision of employees.

"The National Safety Council in its publication 'Accident Facts—1929,' estimates the number of fatalities in the United States arising out of or in the course of gainful employment, as 24,000 for the year 1928, and also that during the same period the lost time non-fatal accidents reached the staggering total of 3,125,000—about one accident for every four persons engaged in industry, or one for every fourteen persons gainfully employed," the introduction continues.

"According to R. E. Simpson of the Travelers Insurance Company, there is warrant for assuming that defective vision and deficient or unsatisfactory lighting installations are contributing factors in 18 per cent of these accidents. Simple computation will show that from these causes industry is being deprived of the equivalent of the services of 35,000 men throughout each entire year due to the lost-time non-fatal accidents, and that the accepted actuarial methods of evaluating fatal accidents will bring the total loss to 125,000 men annually....

"Compensation insurance premiums for a plant are

based on the amount of the pay roll, and the rate is determined by the accident experience of a given industry, modified by the experience of the particular plan under consideration. With a rate of 1½ per cent, the annual premium in the case of 1,000 employees at an average wage of $40 per week would be $31,200.

"An insurance carrier might on an average pay the claims resulting from four accidents per month in this plant, and meet its own overhead costs, and still have a slight margin of profit. An experience of five accidents per month, one-fifth of them due to improper lighting (a not unlikely event), would probably leave the insurance carrier no option but to increase the rate by 25 per cent. The premium would then be $39,000—an increase of $7,800. If poor lighting costs only $3 per employee or $3,000 per year total, the owner's annual expense for poor illumination actually amounts to $10,800—of which $7,800 is required by the insurance company to meet additional accident claims. An expenditure of $6 to $8 per year per employee for more adequate illumination might save a large portion, if not all, of the latter amount. The important point here is the fact that the cost of accidents, due to poor illumination, greatly exceeds the cost of providing adequate illumination."

Savings effected in economy of production by good illumination are a significant item to the factory owner. The estimate prepared by the committee in charge of the code assumes that one 100-watt incandescent electric lamp will take care of one operator; that the lamp burns on the average of two hours per day, 300 days per year; that the life of the lamp is 1,000 burning hours; and that the operator works eight hours per day, 300 days per year, at 45 cents per hour. The total cost of maintaining good illumination, including the investment and the annual operating cost, is, therefore, placed at $6 per man per year. The cost of labor (the annual wages per man per year) are estimated at $1,080. If an operator, because of good illumination, saves in production or in better quality of product the equivalent of only three minutes per day for 300 days, he will offset the annual cost of the illumination. Conversely, the operator losing, for example, 30 minutes per day through poor illumination loses $60 per year, or ten times the cost of providing proper lighting.

EXTRACTORIALS

Now is the time for the chemical man to eye the future of his product and to lead in opening markets. Price cutting and unlimited credit will never aid a lagging industry.—*Plastics.*

The installation of new and modern equipment may be expressed as a direct proportion in the following manner: The cost of new equipment is to the efficiency of the old equipment, as the efficiency of the modern equipment is to the cost of the old equipment.—*Nat'l Laundry Journal.*

With the development of new dyes, and the increase in knowledge, the old dyer who did not keep up, and comparatively few did, was forced out, and better trained men were employed. The change was made quietly but rapidly, and so far as the condition which existed 20 or 25 years ago is concerned, there has been a revolution. This has been based on necessity and has resulted in distinct progress, but has made scarcely a ripple in the trade.—*Daily News Record.*

The foreman, under favorable surroundings, holds a tremendously important place in the safety gamut. He is closer to the men. His supervision and contacts give him opportunities that no other official has. His keen eye can detect the unsafe way or the missing goggles or the violated rule. If he is stern and yet kindly in doing his duty, he will get results.—*United States Daily.*

There have been more improvements in the field of textile machinery in the last ten years than in the thirty years previous, and more in the last two years than in the previous ten.—*From the Institute's depreciation brief. —Textile World.*

Few elements of physical property in use ever become completely worn out. After a certain amount of wear, a point is reached at which good engineering or economy requires their replacement. They may be still further used, but only at the cost of economy and safety. After a given time the expense of maintenance on equipment will become so large that it is better to replace it.—*R. De Vere Hope in Am. Silk Journal.*

More than 200 industrial engineers questioned by the research division of an Eastern industrial engineering corporation are reported to have agreed that the foundations of industry are sound and that progressive principles of management, based upon research in individual industries, offer the best solution to present problems. The report on the survey cites many specific cases where industries handicapped by growing difficulties have been saved by the application of engineering principles based upon surveys that revealed the need of new and improved methods in management, manufacturing, and merchandising.—*Domestic Commerce.*

Inventories are being reduced in practically all industries from manufacturer to retailer. The consumer, too, has been "making things do, just a little longer than usual." Price competition has been trying to encourage buying, but with little result up until now. Sooner or later stocks will be depleted and must be replenished, and we believe that that time is not far off. In fact, the present time, in a good many instances, is the right time to "stock up." Indications are that there will be a "come back" this fall.—*Business Bulletin.*

Padding Cotton Fabrics with Vat-dyes*

By **S. BULLOUGH**

IN direct padding a better production can be obtained than in dyeing, and now that faster shades are being required, we must at once turn to the vat colors as the fastest possible ones to use. The heavier shades, of course, will be dyed in the usual manner, but for the lighter shades an increased output can be obtained by the padding method. In padding with vat colors there are quite a number of points to consider, which are given below.

The box used for these colors should hold approximately five gallons of liquor, and, as in the case of direct padding, a guiding roller is inserted beneath the surface of the liquor. There should also be a closed steampipe running twice the length of the box, in such a manner as not to come in direct contact with the material running through. Also there should be a middle fitting to insure a flow of the padding liquor from the back of the box to the front. This gives the color a chance to go on to the piece evenly, as the material runs into the box at the front. In addition to this center-piece I should also recommend a number of draining pipes spaced equally along the bottom of the box, about one foot apart, giving a flow of liquor in the same direction—i.e., from back to front. This will also insure a better chance of level results, as the freshly introduced color solution will be diffused through the old liquor before coming in contact with the material. Such an arrangement is indicated in the figure.

The speed of the machine may be anywhere between 20 yds. and 50 yds. per min.; but, of course, it is advisable to have a definite constant speed for consistent results.

It is essential to select the colors most carefully. Paste colors are the most suitable, and they must be: (a) Very finely ground; (b) reduced very easily—i.e., quickly; (c) in combination shades they must be chosen very carefully in this respect—if three colors are being used for a certain shade, it will not do to take one which reduces and pads at 120° F., one at 140° F., and the other at 150° F., but they must be reducible at, or near, the same temperature.

An adjustment can, however, be made which gives a wider range of suitable colors for padding, thus—

Suppose we use three colors: (a) Reduces and pads at 115° F.; (b) reduces and pads at 130° F.; (c) reduces and pads at 140° F. Reduce the three colors separately at their normal temperatures, but in the padding box keep the temperature at 115° F.—i.e., pad at the lowest temperature of the three colors used. Of course, this will make a slight difference in the strength or tone of the higher temperature colors, but once a shade has been matched in this manner, consistent results will be obtained in future paddings done in this way.

It is advisable to choose colors of the same fastness, as if one color fades more quickly than the others the shade will be changed to a greater extent than is shown in a dyeing.

In applying the vat colors by padding, another essential point to watch is the temperature, as a difference of 10° F. will make a change in the depth of shade, sometimes of 20 per cent, and as we are dealing only in light hues, as a rule this will be fatal from a selling point of view. Also in combination shades the tone will vary considerably. The cloth must be perfectly dry, and no lint present on entering the padding liquor.

The splashing of liquor in the machine on to the cloth before entering is obviated by a screen which is fitted between the dry cloth and the cloth leaving the padding box.

Damp places cause light patches, as they resist the vat color, so that it is essental to enter bone-dry.

Put the necessary vat dyestuff into a bucket or mug, together with any penetrant that may be used. This is not essential, but some people use Nekal BX or Oranit BF, etc., especially for heavy cloth.

Add about a third of the necessary amount of caustic, dilute to a convenient volume with hot water, and reduce with about a third of the required amount of hydrosulphite.

Allow the color to stand for a few minutes. The rest of the caustic, together with the required amount of oleine-anthraquinone std., is added to 40 gals. of water, previously heated to the required temperature, and the remainder of the hydrosulphite powder is stirred in until the liquid assumes a red color, due to the reduction of the anthraquinone.

When the solution of the reduced dyestuff is added, the liquor is ready for use; it is advisable, however, to let it stand for about five minutes to insure complete solution.

For very pale shades it is beneficial slightly to increase the hydrosulphite content above that indicated by the general recipe.

GENERAL RECIPE

x.	pints	color paste (single	Made up to 45 gals.
x.	"	oleine-anthraquinone standard	
1½x.	"	caustic soda 90° Tw.	
1½x.	lb.	hydrosulphite conc. powder	

OLEINE-ANTHRAQUINONE STANDARD

4 gals. oleine.
1 quart anthraquinone, 30% paste.

After running through the bowls, an air passage is given of about 12 yds., and the goods are piled on the wagon.

While lying on the wagon the edges of the cloth appear to be oxidized more than the inside of the laps.

*Lecture to the Guild of Calico Printers, Bleachers, Dyers, and Finishers' Foremen.

No variation in shade, however, is noticed after the following treatment:

Allow to stand for one to four hours, then run into a chrome bath of about the same strength as is usual in chroming a vat-dyeing. Perborate of soda can also be used instead of chrome.

Next, run through cool water, two becks of soap at 160° F., and finally through a good clear water. Squeeze or hydro-extract, and dry.

The goods are now ready for passing on to the finishing department. Of course, it is not to be expected that all goods which are padded will be perfect, so that various treatments for the commoner faults will probably be of interest to you.

The chief trouble will be unevenness, and this can be removed in the following manner:

Run in a jig in the following:

2-3 lbs. hydrosulphite powder
4-6 pints caustic soda 90° Tw.
2 pints oleine
½ nogg. anthraquinone
½ lb. Leucotrope W.

} Made up to 50 gals.

Begin cold, and raise the temperature to about 180° F., give two ends at this temperature, soap, wash, and dry. If necessary, the goods will now have to be topped up to shade.

The following method can be used if the shade obtained is too strong. Sometimes the shade obtained is off-tone—say, for instance, that a bluish helio is required, but that the tone obtained is rather too red; if, however, a blue is introduced, too strong a shade will result. In this case treat as follows:

Make a solution of—

4 gals. caustic soda 90° Tw.
4 " glucose syrup.
8 " soap solution (about 6 oz. to the gallon).

Make up to 250 gals.

Run for 45 mins. to one hour in either a jig or a rope beck at the boil. The goods must now be rinsed thoroughly, dried, and topped to shade.

In conclusion, I would say, watch the following points carefully:

1. Choose color pastes with great care; see that they are finely ground and reduce quickly, and that in combination shades they reduce and pad at the same temperature with the adjustment already mentioned.

2. Use clean utensils and machinery all through. Cleanliness is next to godliness. Far better is it to start clean than to have to strip and re-pad.

3. Watch the liquor in the feed-box as well as the color actually in use.

4. The cloth must be bone-dry, and no lint present.

—*Textile Manufacturer.*

Technical Notes from Foreign Sources

Chemical Cleansing

Dr. C. F. Goehring—Leipziger Monatsch. f. Textile-Ind. 44, 537 (1929).—From a paper of general scope by G., entitled "A Survey of the Field of Washing and Chemical Cleansing," the section above titled contains some remarks which, while doubtless well known to many, deserve to be noted.

The title, Chemical Cleansing, is the German equivalent for what we in this country call dry-cleaning, the removal of oily spots or smears by immersion of the goods or article in an organic, non-aqueous solvent. Through solution of the fatty matter by the solvent, the cause of the adherence of dirt, etc., to the goods is removed, and the actual dirt, thus isolated in a finely divided, granular form, can be easily removed by shaking, brushing, beating, etc. In wet washing (with water as a solvent, colors which are not sufficiently fast will run or wash out entirely, the tone of the goods is very liable, at least, to alter, and the goods frequently fall off in luster or fullness; but with the solvents commonly used in dry cleansing these dangers are never present. One difficulty in the process, however, has a superficially strange explanation; a properly dry-cleansed article may appear spottier after cleansing than before, due to the greasy matter, the spot, having been dulled in tone by the adherent dust which had settled upon it. This should, of course, not be true if no spots of any kind were already present upon the goods, unless the material which gave rise to the spot were chemically active toward the dyestuff used upon the fabric, which is hardly ever the case; or possibly the explanation may be, that in some cases the solid dirt-substance which formed the "coloring-matter" of the grease is of such a finely divided nature that, even when loosened by removal of the grease-element, it cannot be entirely dislodged by even vigorous brushing, etc. (Gudgeon-grease, for example, containing finely divided carbon, would cause such only partially-removable spots.) In such cases, the spots have to be treated with suitable compounds, dyestuff solutions, etc., until they match the surrounding areas.

The goods, of course, have to be thoroughly dry before being cleansed in an organic liquid, as benzine. If they are not quite dry, the use of even pure benzine gives only unsatisfactory results. In the '80s, "benzine-soap" was introduced. This substance consists of the acid potassium or ammonium salt of oleic acid, prepared by adding the true soap to an alcoholic solution of oleic acid. Such a substance dissolves well in benzine, etc., the solution will

form a "suds," and the benzine bath becomes a washing-bath as well as remaining a solvent bath. Reasonable amounts of water present as dampness in the goods are taken up by the benzine soap in solution, and so do not cause streakiness in the goods, due to repulsion of the benzine by the moisture.

The use of such a benzine soap in a bath of so inflammable a substance as benzine carries with it a collateral important advantage, that of greatly diminishing or usually obviating the very great danger of ignition of the vapors of benzine through electrical sparking. When wool or silk is worked in benzine, static (the old frictional) electricity is generated, the goods becoming positively, the benzine negatively, charged. When the goods are drawn out of the bath by hand, sparking may occur between the goods and the surface of the bath, or the hand and the bath, etc., and this sparking is very likely to ignite the vapors of benzine coming off from the surface of the bath. (The same situation arises from the agitation of gasoline in gasoline delivery trucks, the gasoline assuming one electrical charge, the metal tank the other; as the metal tank is insulated from the ground by rubber tires, it sometimes happens that when the operator, standing upon the ground, approaches his hand to the tank-cock, sparking between his hand and the cock takes place, with consequent ignition of any gasoline-drip which may exist. This trouble is avoided often by attaching a metal chain to the tank, of such length as to touch the ground and trail slightly, the electrical charge of the tank being thus discharged by grounding. In the case of the above situation, it would hardly be possible to ground the contents of the cleansing tank, either goods or fluid, each being non-conducting.) The chief conditions for the dangerous occurrence of such electrical charging and ignition of vapor are dry material, dry benzine, and dry, dust-free, cold atmospheric conditions, which hinder the gradual diffusion of the electrical charges. Days with a low dew-point are "critical days of the first order for dry-cleansing" (the expression of M. M. Richter, who first explained the cause of "dry-cleansers' fires"). The danger is great in winter, much less in summer. It was Richter who proposed adding to the bath anhydrous oleate of magnesium to diminish the danger (see benzine soap above). Goehring, the author of this paper, first proposed the addition of benzine soap. But, whichever is used, either agent must remain dissolved in the bath, and not be present simply as a sludge, thrown out by cold weather.

Of course, there are now on the market adequate machines for accomplishing dry cleansing, in which the whole process is carried out enclosed. In several of these systems, the air-space within is filled with carbon dioxide, nitrogen, etc., instead of air. Davy-gauze also protects any necessary openings.

It must not be forgotten that benzine vapors are also very dangerous if adequate protection is not insured from fire, lights, etc. (assuming that furtive cigarettes can be counted out). Heating must take place by indirect steam, illumination by inclosed incandescent electric lights, of which the switches must be located at a safe distance, in another part of the establishment. For these reasons, benzine is being replaced by the chlorinated hydrocarbons, carbon tetrachloride, trichlorethylene, etc. These are considerably heavier than benzine, and much higher in cost per kilo, which makes the cost of a bath of any respectable size a serious matter; further, their vapors are decidedly prejudicial to health, much more so than with benzine; they are in some cases definitely toxic; but their use in properly constructed, closed apparatus is already competing with that of benzine, though this latter at present is still in the lead.

Hydrogen-Ion Concentration and Its Importance to the Textile Industry

Dr. Erich Baur—Textil-Chem. u. Colorist 11, 49 (1930).—An article of general and somewhat elementary nature, of a didactic kind, whose intention is evidently to "sell" the idea of the title to German industries. The closing paragraph reads "Up to the present, pH determination has found little acceptance in the German textile industry, because the whole matter is still rather a new thing. America has already introduced it into several branches of the industry. What has been stated in this discussion of the possibilities of its usefulness makes no claim to completeness. It is the business of science to work out problems which arise, through the most intimate co-operation with practise."

It seems strange that the subject of pH control, which enjoys astonishingly universal approval in this country, should up to the present have been so largely ignored in a country so keen as Germany in seizing upon the most recent developments of science.

Increase and Control of Affinity of Cellulose Esters for Dyestuffs

German Patent No. 433,144 (*addition to G. P. No.* 389,401)—*I. G. Farben-Ind. A.-G.*—In the original patent, certain aldehydes or derivatives of them are recommended. In this supplementary patent, such compounds can be replaced partly or wholly by salts of aromatic sulphonic or carbonic acids, or by mixtures of these.

Developer Salts

German Patent No. 433,150 (*addition to G. P. No.* 421,837)—*I. G. Farben-Ind. A.-G.*—The original patent involves the use of mineral-acid salts of diazotizable unnitrated and unsulphonated aromatic amines. The present patent replaces such compounds by the dry N-sulphonic acid derivatives of diazotizable aromatic amines or their salts. For example, one mixture is composed of 23.1 parts of the dry sodium salt of naphthalene-sulphonic acid, 25 parts of Glauber salt, and 36 parts of sodium bisulphate, intimately ground together and mixed gradually with a mixture of 7 parts of dry sodium nitrite and 20 parts of dry Glauber salt. Such a mixture, dissolved in cold water and allowed to stand for a reasonable time, affords a diazo-solution ready for use.

New du Pont Dyes

The Dyestuff Department of hte du Pont Company announces the development of Leucosol Brown 3R Double Paste and Pontamine Diazo Blue NA. The former is a vat color of the anthraquinone series prepared especially for printing. It is stated that it possesses the characteristics of the Leucosol group of colors and is exceedingly fast to all destructive agents with which the color is likely to come in contact either during the printing or finishing processes or later during the life of the fabric.

The Diazo Blue is a direct color which, when diazotized and developed with beta-naphthol, yields reddish shades of blue. It is said to be particularly suitable for the production of navies and, in combination, for a wide range of dark blues and violets. The company states that it is suitable for use on all types of machines and is of particular interest for jig dyeing and padding.

Clemson College Exhibit

The Clemson College Textile Department will maintain an exhibit at the Southern Textile Show in Greenville, October 20th to 25th. Director H. H. Willis extends a cordial invitation to all chemists, dyers, executives, and other mill men to visit the Clemson booth. Among the features of the exhibit will be a large display of rayon and synthetic yarn materials in all stages, from the crude cellulose to the printed or dyed and finished goods.

There will also be a display of hydrogen ion concentration determination, or pH control, apparatus of various types. Several attendants will be present to explain and discuss the manipulation and applications of each type of equipment. Visitors will be invited to make any inquiries they may wish.

An additional exhibit, which will be of considerable interest, is a display of modern textile materials from all parts of the world, which will form the background for the other features.

The rate for "Position Wanted" advertisements in this column is 2 cents a word—with a minimum of 50 cents per insertion. For all other types of advertisements—i.e., help wanted, machinery or supplies for sale—the rate is $5.00 per column inch or less per insertion.

POSITION WANTED

Textile graduate, 3 years' plant and laboratory experience, wants position as assistant colorist, chemist or assistant superintendent. References gladly furnished. Address: Classified Box No. 642, American Dyestuff Reporter, 440 Fourth Avenue, New York, N. Y.

POSITION WANTED

Printer, 35 years of age, married, specializing in pile fabrics, plushes and fur imitations, six years in charge of printing department in one of the largest plush mills, wishes similar position. Address: Classified Box No. 641, American Dyestuff Reporter, 440 Fourth Avenue, New York, N. Y.

POSITION WANTED

Superintendent of Dyeing; long experience on Cottons, Silks, Rayons and all mixed fabrics. Thoroughly conversant with Basics, Directs, Developed and Vats, on Pads, Jiggs and Reels. Capable of taking charge of any piece goods dye plant. Will locate anywhere. Address: Classified Box No. 637, American Dyestuff Reporter, 440 Fourth Avenue, New York, N. Y.

POSITION WANTED

Textile Colorist, 13 years' experience in dyeing, calico printing, and standardization, wishes to make change. Preferably with dyestuff manufacturing concern: Address: Classified Box No. 639, American Dyestuff Reporter, 440 Fourth Avenue, N. Y. C.

POSITION WANTED

Chemist and practical dyer with record of two positions in many years, is desirous of locating with a Worsted, Woolen, Union or Cotton Mill where his knowledge obtained with a dyestuff firm in all classes of colors, and his many years' practical experience in the dyehouse will be of the greatest benefit. Address: Classified Box No. 640, American Dyestuff Reporter, 440 Fourth Avenue, New York, N. Y.

CHEMIST-EXECUTIVE AVAILABLE

Textile Chemist and twenty-two years' practical experience. Graduate Lowell Textile Institute. Four years instructor in Chemistry and Dyeing. Three years theoretical and practical experience in Peroxide Bleaching. Fifteen years in charge of chemical work in large textile plant. Experienced in purchase of dyes and chemicals. Excellent analyst, and one who can interpret results.

Would consider position as technical advisor to chemical or dyestuff executive. Address: Classified Box No. 638, American Dyestuff Reporter, 440 Fourth Avenue, New York, N. Y.

POSITION WANTED

Dyer and Tin-weighter with 25 years' successful practical experience in all lines of silk piece dyeing, conversant in dyeing of rayon, celanese and all mixed fibers, chemical education, scientific tin weighting. Best references, desires position as superintendent or manager. Will locate anywhere. Address: Classified Box No. 635, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.